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The Big Stick

By Rufus T. Strohm

Back in the days when I wore knee pants
And garden work was a circumstance,
If father told me to hoe the beans,
Or pick the bugs from the growing greens,
Or make a bed for the humble squash,
Or train the cucumber vines, b'gosh,
I went and did it, the best I could,
And that, believe me, was pretty good!

Though toil is a thing most boys dislike,
It never entered my head to strike,
Nor was I tempted to slight or shirk
Or practice soldiering in my work;
For well I knew I'd be playing hob
If I made a botch of that garden job,
Since there'd be a conference of three—
My dad, and a barrel stave, and me!

Now, I'm not keen on the sort of thing
Like a kaiser, emperor, or king;
A bit of them is a *quantum suf.*—
Or what we commonly call "enough";
For though a few may be good, egad,
The common run of the lot is bad.
Still, what we need in the present hour
Is an autocrat with a big-stick power.

And they who hindered the nation's life
By brewing trouble and stirring strife
Would all be haled to the autocrat
With the iron arm and the cordwood bat,
And brought to the proper frame of mind
To toil for the good of humankind;
For work's the thing that the country needs—
We're long on talking and short on deeds!

Electrically Driven Steel Reversing Mills

By FRASER JEFFREY
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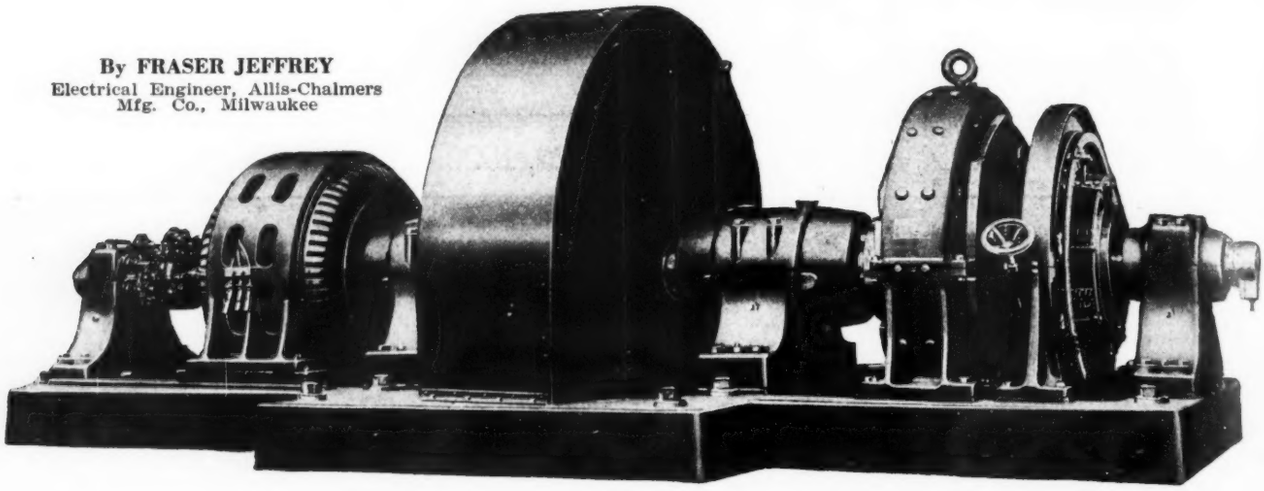

Tonnage output per cost of operation and maintenance rather than first cost is the basis on which electricity is efficiently replacing steam as a mill drive. Features of an interesting installation in which a reversing motor and its necessary complements replaced an engine unit.

ONE of the prime points of consideration outside of the "cost per ton" in any steel-mill installation, is the "tonnage output per cost of operation and maintenance" rather than the "tonnage output per first cost." This may seem somewhat paradoxical but is evidenced more or less all the time by the large number of mills that are constantly changing over from low-first-cost units to equipment of higher first cost; namely, steam to electric drive. Higher first cost means little if in a reasonable length of time the saving in cost of operation and of maintenance will more than offset it to the extent of showing appreciable gains. For this reason electric drive in the steel mill, in view of its higher efficiency than the steam drive, is more than making up the difference due to its higher first cost.

In the older type of steam-driven mill of today, the buildings have been built up around the equipment in such a manner that no radical changes can readily be made in the mill layout. In many cases the mill property is limited in size such as would prohibit any radical expansions in the new building layouts, and in general the whole sequence of operation is dependent and radiates from the two-high steam-driven reversing blooming mill.

Competition has become keen of late years, with the result that the different mills are desirous of reducing the cost per ton of their product in every way reasonably possible. It is usually only a question of time when the reversing engine will reach the state where practically complete renewal is needed. This may not occur for a long period, many of these faithful old engines having seen more than twenty years' service; nevertheless, they do wear out just as any piece of machinery will. When this point is reached there are several courses open to the mill owner; First, the old engine can be renewed; second, the engine can be replaced by a reversing electric motor and its necessary complements; third, the engine, mill, buildings, etc., can be replaced by a continuous-running electrically driven mill.

If the engine is renewed, the cost per ton of product and the total tonnage will remain practically the same as before. If the engine is replaced by a reversing electric motor with auxiliaries, the cost per ton of product will be reduced, but the first cost versus that of the engine will be greater, the total tonnage remaining practically the same as before, provided the mill has already been worked to its full capacity.

The replacing of the engine, mill, buildings, etc., by a continuous-running electrically driven mill is obviously prohibitive and not to be considered.

This is, then, the problem facing the older type of steam-driven mill—a question of still adhering to the steam, or one of electrification. As a natural consequence it is the electrification of these kinds of mills that is largely responsible for the reversing motor of today. When considering an entirely new electrically driven blooming mill, the continuous-running type is seldom selected (only one mill of this kind being in existence in this country today) because it can be considered only for mills turning out an extremely large tonnage and usually of one particular product. The first cost, not only of the electrical equipment, but of the mill equipment, buildings, etc., is so large as to practically limit its use to this kind of mill. The selection, however, is governed more or less by local conditions and such things as first cost, material to be rolled, conditions of rolling, tonnage, etc. The continuous mill is naturally more efficient than the reversing type, and it is also a proved fact that the reversing motor is more efficient than the reversing engine. Giving the engine due credit, it may be stated that on any given mill it can be made to turn out as much tonnage as the electric motor. In efficiency, however, it loses out considerably, and this is the potent item in these days of keen commercial rivalry. Within recent years there have been erected several entirely new plants in which steam drive has been used, but this is largely on account of special prevailing conditions and is more the exception than the rule.

Electrification may be carried to the extent of installing a complete plant from prime movers to motors and

the necessary auxiliaries, or it may mean only the installation of the large main-drive motors and their auxiliary equipment. A great deal depends on the size of the mill and the local conditions, as to whether or not power should be generated at the mill or advantageously bought from some one of the local power companies. It is a matter of record that in most of the older steam-driven mills, electricity is used for the operation of the screw-downs, tables, cold saws, etc.

At one steel plant the reversing engine on the main plate-mill drive reached the point where one of the

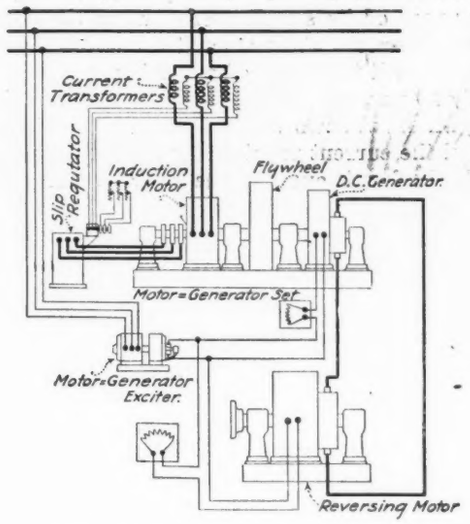

FIG. 1. ELECTRICAL CONNECTIONS OF REVERSING MOTOR AND AUXILIARY EQUIPMENT

three courses of procedure previously given had to be considered, with the result that the second one was ultimately decided upon. The equipment that replaced the steam engine has now been in operation for nearly a year and has shown results fully substantiating the original contention that it would be better to electrify the old mill even at a higher first cost than it would be to replaced the engine.

The installation has some unique features that may be of general interest. It consists of a direct-current reversible motor direct connected to a two-high, two-stand mill. A flywheel motor-generator set transforms alternating current to direct current, the commutator of the direct-current generator on the set being electrically connected through an automatic reclosing circuit breaker to the commutator of the direct-current reversing motor. An automatic liquid slip regulator with a special torque motor controls the line peaks by allowing the flywheel to give up its energy at certain predetermined points, while a small exciter motor-generator set, under control of a master switch operating in conjunction with full magnetic-type control panels, governs the fields of both the generator and the motor. In this manner a speed range from zero to 70 r.p.m. is possible and is required on account of the high-grade alloy steel that is rolled in one heat from the bloom to the finished product in passes varying from 15 to 25, depending on the size and nature of the material being rolled. The sequence of operation is such that under certain rolling conditions a 10 x 12-in., 800-lb. bloom of hard, tough alloy steel is rolled to a final product 16 in. wide and $\frac{7}{8}$ in. thick. The roughing and edging is done on the first roll stand, the passes being short and at low speed. The material without reheating is then transferred by an electrically driven table to the second roll stand, where the passes are of long duration and accomplished at fairly high speed. To meet the varying conditions required, the master controller is so arranged that 23 speeds forward and 23 speeds reverse are obtainable. A simplified wiring diagram of the connections is shown in Fig. 1.

A complete oiling system of sufficient capacity to lubricate the bearings of the reversing motor and the flywheel bearings of the flywheel set is provided. This includes a motor-driven oil pump supplemented by a steam-driven oil pump for use in case of failure of the main supply line. This insures a constant flow of oil to the bearings, as the flywheel set, owing to its own inertia, will not come to rest for 1½ hours after the main-line switch is opened.

The speed and torque control is governed through a master switch and two contactor panels shown by Fig. 2. On one panel are mounted a circuit-breaker switch, a set of reversing switches, accelerating switches or speed points and a current and voltage relay. Instead of opening the main circuit, the circuit-breaker switch opens the field circuit of the generator, thereby making it unnecessary to handle large currents at high voltage. The current relay governs the strength of the motor field relative to the generator field, and the voltage relay prevents reclosing of the circuit breaker until the generator voltage has dropped to zero, and the master switch is returned to the off position.

On the other panel are a number of switches for weakening the field of the motor for speeds above normal and relays and switches for controlling this operation. The switches for weakening the motor field are selected by the master and will insert or cut out the resistance, corresponding to the position of the master switch, the latter providing a means of selecting the direction of rotation and the speeds desired.

The headpiece shows the four-bearing flywheel motor-generator set comprising a 900-hp. 2200-volt

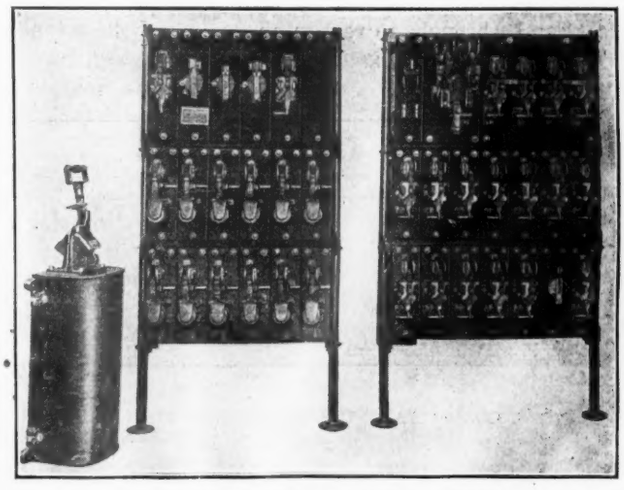

FIG. 2. MASTER SWITCH AND AUTOMATIC CONTROL PANELS

three-phase 60-cycle 720 synchronous r.p.m. induction motor; a 9.5-ft. diameter, 45,000-lb. machined plate-type flywheel fully inclosed in a sheet-metal casing and a 700-kw. 525-volt direct-current generator. As the stator of the induction motor can be moved axially, thus exposing the rotor and stator for inspection and

repairs, it is unnecessary to disturb the shaft and integral flywheel in any way whatever.

Including windings, slip rings, etc., the rotor is made suitable mechanically and electrically to withstand the shock of "plugging" and is used principally for bringing the rotating parts to rest when shutting down the set. Some idea as to the inertia of the moving parts is

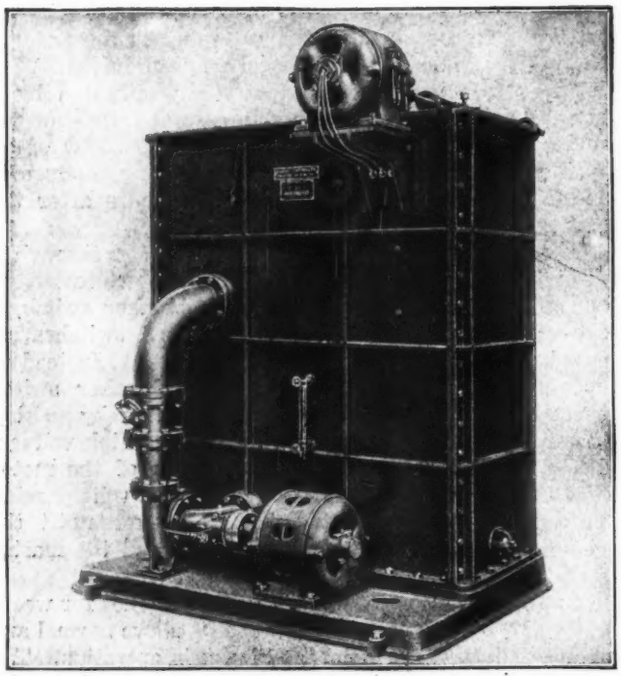

FIG. 3. LIQUID STARTER AND AUTOMATIC SLIP REGULATOR

obtained from the fact that it takes the set about 1½ hours to come to rest from full speed, the retarding effort being its own windage and friction only. By tying in the mill motor and mill, stopping can be effected in some twenty minutes, while by full "plugging" the set can be brought to rest in approximately 3½ minutes. The direct-current generator is of the shunt-wound interpole compensated type, especially designed for "black" commutation of heavy overloads in current up to 3,870 amperes. The shunt fields are wound for 250 volts and are controlled by means of the master switch operating in conjunction with a 25-kw. induction-motor-driven exciter set. In this manner not only varying field strengths are obtained, but the polarity can be reversed also, thus changing the direction of the armature current and accomplishing the reversal of the main mill motor whenever desired.

The starter and automatic slip regulator of the liquid type, Fig. 3, consists of an iron tank containing the electrodes and electrolyte, a motor-driven centrifugal circulating pump, a torque motor operating a set of weirs controlling the electrolyte level and the necessary operating accessories such as no-voltage release, plugging valves, accelerating valves, etc. It is designed not only for "plugging" conditions, but to start the motor-generator flywheel set from rest and bring it up to speed, and then automatically vary the speed in order to increase the slip so as to permit the flywheel to deliver part of its stored energy when the demand for power is in excess of the amount for which the regulator is set. It will take care of a maximum slip of approximately 20 per cent, thus allowing a speed variation on the flywheel set down to 80 per cent of full-load speed.

When the current required by the induction motor of the flywheel set exceeds the amount for which the regulator is set, the torque motor operates the weirs, thus introducing resistance in the secondary circuit of the induction motor and permitting the flywheel to give up some of its stored energy. When the current demand decreases again, the reverse operation takes place and the set is automatically brought to its normal speed.

The iron tank of the regulator is divided into an upper and lower compartment, there being interposed between the two a large butterfly valve. When the main-line switch to the motor of the flywheel set is closed, the electrolyte in the regulator is at its lowest level, and consquently, full resistance is in the rotor circuit. Closing the butterfly valve, which is then held in position by a magnet coil and catch, starts the circulating pump motor and causes the electrolyte level to rise and bring the induction motor to speed. Another butterfly valve located in the discharge pipe of the circulating pump can be given various adjustments so that the rate of acceleration can be varied at will. The magnet coil and catch on the large butterfly valve serves as a no-voltage release and also acts in conjunction with the "plugging" switch, dumping the electrolyte from the upper to the lower compartment, thus inserting full resistance in the rotor circuit of the induction motor.

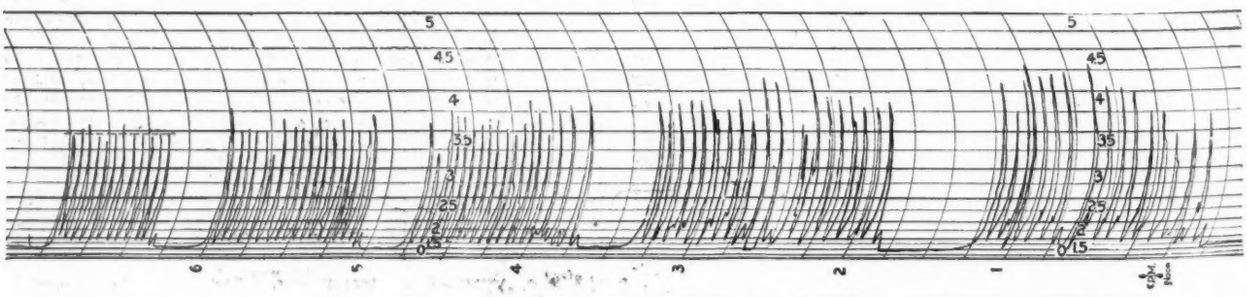

FIG. 4. LOAD CHART TAKEN ON LINE SIDE OF INDUCTION MOTOR OF FLYWHEEL SET, WITH REVERSING MOTOR UNDER HEAVY PEAK-LOAD CONDITIONS

Regardless of the heavy peak-load conditions imposed on the reversing motor, the automatic regulator smooths out and equalizes the power from the line, as shown in Fig. 4. This is an actual load chart taken on the line side of the induction motor of the flywheel set when the reversing motor was working under heavy peak load.

Reading from right to left the chart shows the load conditions from 12 o'clock noon until 7 o'clock at night.

The final setting of the regulator was not made until 6:10 o'clock in the evening, so that from 12 o'clock until 6 o'clock different settings were made during the intervals at 1 : 15, 3 : 20, 4 : 50 and 6 : 10 p.m. to allow the flywheel to carry more and more of the load. For this reason a gradual reduction in the peaks on the induction motor is quite noticeable. It should be noted that the same condition of rolling prevailed throughout the entire period of time shown, and the chart gives a good idea as to what can be accomplished with a regulator of this kind acting in conjunction with a flywheel. In the final setting, from 6 to 7 p.m., the regulator was adjusted for a current load on the induction motor corresponding to the dotted line shown.

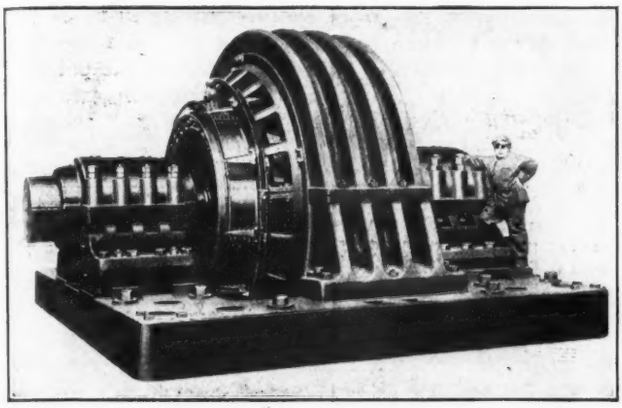

FIG. 5. COMMUTATOR END OF REVERSING PLATE-MILL MOTOR

The main reversing motor, Fig. 5, is provided with a compensated winding in the faces of the poles, in addition to the shunt-field and interpole windings. Its bearings are of the pedestal type, self-aligning, ring-oiling and water-cooled, the pedestal next to the mill being suitable to take the thrust from the mill in case of a spindle break.

The motor has a normal rating of 800 hp. and 2,500 hp. maximum at 37 r.p.m. It is capable of exerting a maximum, repeating torque of 400,000 lb. at 1 ft. radius from zero to 37 r.p.m. and a maximum emergency torque of 425,000 lb. at 1 ft. radius. It is capable of delivering 1,200 hp. continuously without injury; constant torque from zero to 37 r.p.m. and slightly decreasing horsepower from 37 to 70 r.p.m.

From full speed of 37 r.p.m. to the same speed in the reverse direction of rotation can be accomplished in much quicker time than the bloom can be handled for the succeeding pass. As the entering is done at comparatively low speed, the actual period of reversal is even shorter than from full speed in one direction to full speed in the opposite direction. The time element of reversal is therefore more than enough to meet the prevailing rolling condition for both the reduction of the bloom as accomplished on the first stand of rolls and for the finishing of the plate on the second stand of rolls.

A motor-driven blower, located in the room with the flywheel motor-generator set, draws fresh air from outside of the building, discharging it through a concrete duct to the lower back end of the reversing motor. Part of the air goes into the rotor spider and out through the ventilating ducts and commutator necks past the commutator and the balance past the field coils out above the commutator. While a reversing motor of this kind is given a certain definite guarantee as to temperature rises for various loads, it is much more important that the commutation will be such as to be consistent with long life and continuity of service. It is inconsistent to set a limit of 35 deg. C. rise and sparkless commutation for average load conditions, if at peak loads the commutation becomes dangerous.

From the smaller type of steel mill there is usually a demand for quite a varied product as to length, width, thickness, shape, etc., that has to be accomplished by being able to meet these different requirements with the one available equipment. This sometimes involves apparatus capable of varied speed ranges, and as the conditions of one mill are oftentimes totally different from those of another mill, it is seldom that any two are alike. This involves a specialized study of each condition to be met in order that the proper equipment can be selected.

On the other hand, in some of the larger mills rolling a more or less standardized product, such as rails, rods, plate, etc., the power requirements are fairly well known and the equipment more or less standardized. Therefore, owing to the already numerous installations on which data are available, and in being able to closely estimate the power required for rolling steel, there is at this time no difficulty in determining within close limits the power required to drive any given mill working under any given condition.

Don'ts for the Diesel Engineer

Don't neglect to filter all your fuel oil.

Don't delay regrinding the valves until the engine stops from lack of compression.

Don't fail to clean the fuel-oil filters at stated intervals.

Don't try to put the cylinder-head nuts on the wrong studs. Mark both stud bolt and nut.

Don't forget to examine the main bearings at every opportunity.

Don't neglect the bleeder or drain on the air-compressor discharge line. Moisture in the air makes the engine hard to start.

Don't allow the air-compressor discharge to reach a high temperature; a plentiful supply of lubricating oil and a high air temperature have exploded more than one air bottle.

Don't use too much compound in grinding the fuel valves. Use it sparingly and so avoid grooving

Don't forget to examine the needle-valve seat when grinding the needle. A pocket flashlight will lighten up the interior of the valve cage.

Don't think the air-compressor intercooler will operate forever without cleaning.

Don't allow the fuel needle-valve spring to become weak. High-injection air pressure may, in such event, cause the needle to wedge open.

Don't neglect to drop a little kerosene on the exhaust valve stem each day. This will prevent gumming where a heavy fuel is used.

Don't flood the air compressor with oil. Two or three drops per minute per cylinder is ample.

Don't neglect leaks around the fuel pump plunger. When repacking, remove all the old packing, filling the stuffing box with new material.

Don't attempt to tighten a leaky air-line joint under pressure.

Correct Height of Return-Tubular Boiler Above the Grate

By HENRY MISOSTOW
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For best results with bituminous coal the shell of a return-tubular boiler should be set as near the fire as possible and still provide ample room for the gases. The result is not only better heat absorption, but also better combustion, due to the lower furnace temperature and the less-violent distillation of the volatile.

TO MAKE his argument in favor of higher settings for return-tubular boilers impressive, John A. Stevens in the March 30 issue of *Power* claims it to be in accord with "modern practice." Whether a particular distance from the grate to the shell is, or is not, modern practice, is of small importance. A mechanical efficiency of 90 per cent and a thermal efficiency of 10 per cent surely indicate that there are still possibilities before us.

As to "gratifying results" from modern practice, an actual incident of recent occurrence may be illuminating. Recently, the writer designed a furnace intended for high capacity and, incidentally, better economy. A 78-in. by 20-ft. return-tubular boiler was equipped with a device to promote circulation and was to be equipped with forced draft and special grates. With these improvements installed, the combination on test developed 333 per cent of rating and a little better than 75 per cent efficiency. The coal man, forced-draft man and the man who equipped the boiler with the circulating

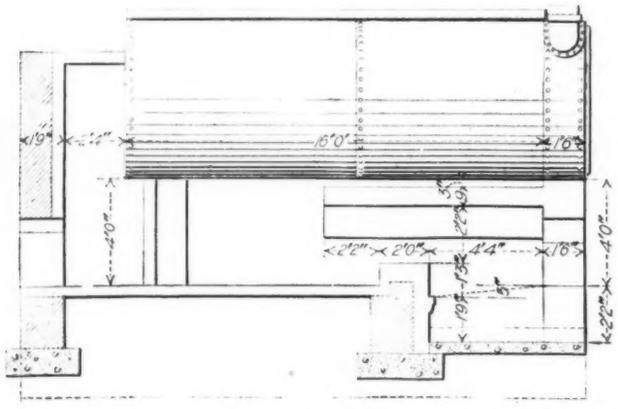


FIG. 1. RETURN-TUBULAR BOILER SETTING WITH LONG DUTCH-OVEN ARCH

device, each claimed credit for the boiler performance, forgetting or ignoring the part played by others.

Boiler performance is the combined result of many factors entering into or contributing to the operation and cannot be claimed or attributed to the height of a boiler setting. In fact, if any one factor should be given credit, it should be the men who operate—the engineer and fireman.

To determine the best distance from the shell of the boiler to the grate, try to visualize factors and conditions in practice which determine this distance, and reduce these to measureable quantities as far as possible. The distance from the shell of the boiler to the grate which makes possible the use of the greatest amount of heat generated in the furnace is to be favored, provided such a setting does not interfere with making available the maximum amount of the potential heat in the fuel. To satisfy these conditions, we must set the boiler as close to the source of heat, which is

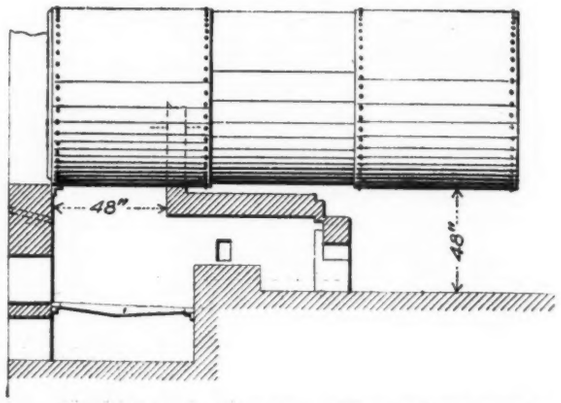


FIG. 2. DUTCH-OVEN ARCH CUT AWAY ABOVE THE FIRE AND DEFLECTION ARCH ADDED

the fire, as possible, and still have a furnace which will allow perfect commercial combustion in the presence of the boiler at the predetermined distance.

Taking for granted that the importance of draft and its utilization is fully appreciated, consider the combustion of bituminous coal. The characteristics of this coal in the process of combustion are unlike those of any other form of fuel, and yet it presents the combined characteristics of all other principal fuels, such as anthracite, coke, oil and gas. Part of it burns on the grates, part is liberated as heavy hydrocarbons in the form of oil vapor to be broken up into gas above the fuel bed, and CO and light hydrocarbons are in the form of gas nearly ready for combustion. The preparatory process before actual combustion takes place, often termed distillation of the volatile, has an important bearing on the results to be obtained. The more violent the process of distillation the harder it is to obtain complete combustion. There is less fixed carbon and more and heavier hydrocarbons carrying a greater amount of free carbon than with anthracite. The less violent the process the less hydrocarbons of the heavy composition containing little or no free carbon. These lighter gases are easy to break up and burn. The rate of distillation, or rather, violence of distillation, is directly proportional to the temperature at which distillation occurs.

This characteristic of bituminous coal being well appreciated by most of the stoker manufacturers, each claims that his stoker is the best means to obtain progressive combustion; that is, coal is being slowly moved into the zone of high temperature, making pos-

sible slow distillation at low temperature and a high-temperature zone for burning the remaining coke or fixed carbon.. So-called perfect mechanical firemen (stokers) that flip the coal have failed in competition with stokers that make progressive combustion possible because in their design the importance of slow distillation at relatively low temperature was not considered.

The foregoing being correct, then close proximity of the boiler is desirable, not only to obtain better

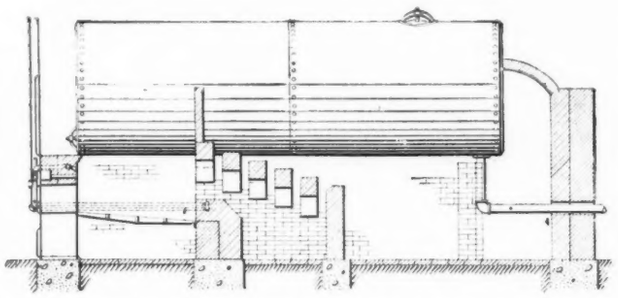


FIG. 3. ONE OF THE FANCY FURNACE DESIGNS SHOWING SLIGHT IMPROVEMENT

absorption, but also to obtain better combustion by reducing the furnace temperature and at the same time reducing the violence of distillation, thereby minimizing the difficulty of handling the volatile part of the coal. The time required for distillation in practice varies from three to ten minutes, depending upon the quantity charged and the furnace temperature, but on an average in hand-fired furnaces six minutes is ample. During combustion air admitted is heated to the furnace temperature, and naturally its volume increases as the temperature increases. Any restriction to this expansion would delay combustion and interfere with the mixing of air and combustible gases. So ample room must be provided for the gases rising from the fuel bed.

Gases on leaving the fuel bed, if the firedoors are closed, tend to rise vertically until they are affected by the force of the draft; then they bend slowly toward the exit and, when in line with or above the bridge wall, are entirely under the control of the draft and take a straight line to the rear of the boiler. Flames, indicating the direction of the gases, seldom impinge against the boiler at right angles, but travel parallel to it. In fact, they do not ascend so as to hug the curvature of the boiler, indicating that the force of the draft gets full control of the gas travel near, and a little above, the bridge wall. The chilling effect of the shell, then, cannot have any material effect on combustion, as the flames travel parallel to the shell, scarcely touching it, for there is a gas strata or film covering the boiler shell that moves at comparatively low velocity, being impeded by the roughness of the metal. Therefore, the space required for combustion will be that space necessary to accommodate the gases rising from the fuel bed at the furnace temperature. Combustion will be carried outward and completed in the combustion chamber without ill effect from the boiler shell, as anyone can become convinced by observation of the facts in every-day practice.

The amount of gas per pound of coal in the furnace seldom exceeds 20 lb. This is augmented by infiltration until at the stack, in some cases, it runs as high as 35 lb. But in considering the furnace space above the grate, an allowance of 20 lb. of gas per pound of coal should be ample. With the boiler set above the fire and free to absorb heat, the temperature in a hand-fired furnace seldom exceeds 1,800 deg. F.; for practical purposes, say there are 52 cu.ft. of gas to a pound of coal. The maximum rate of combustion for a hand-fired furnace can be taken as 25 lb. of coal per square foot of grate per hour. Gases rising from each successive foot longitudinally of the grate, traveling toward a common point and in a straight line, are bound to coincide or join together, forming one mass at or beyond the last unit area at the front face of the bridge wall. The gases rising from the front end as they pass over the second square foot will be doubled, and the gases over the last foot of grate will be as many times greater as the distance traveled by the gases rising from the first square foot of grate, granting that all grate surface is uniformly active.

The maximum rate of combustion being 25 lb. of coal per square foot of grate per hour, and 20 lb. of gas per pound of coal at 1,800 deg. F., or 52 cu.ft. of gas per pound of coal, the required height to accommodate the gases will depend on the velocity. The velocity of the gases in the furnace is at first indefinite, then gradually accelerates as they move toward the bridge wall, and can be taken conservatively as 20 ft. per second. At the front, where the velocity is less, the gas body is smaller, so natural conditions almost compensate each other. The area required to allow the gases from a strip of grate 1 ft. wide and 6 ft.

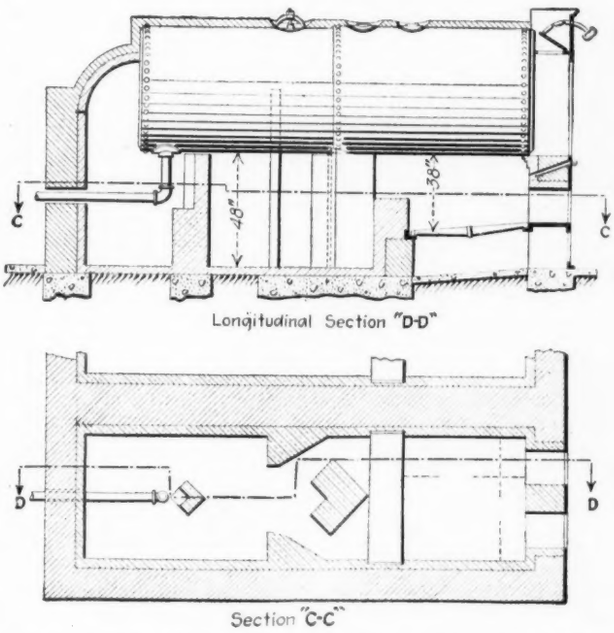


FIG. 4. FINAL DESIGN OF SETTING, KNOWN IN CHICAGO AS NO. 8 FURNACE

long to pass at a velocity of 20 ft. per second is $\frac{25 \times 20 \times 52 \times 6}{60 \times 60 \times 20} = \frac{13}{6} = 2.17$ sq.ft. As the unit width is 1 ft., the height required will be 2.17 ft., or 26 in. Taking the space requirement for the fuel bed and the pitch of the boiler as 12 in., the required distance that the boiler must be set from the grate to provide a space for the change of direction of the gases from the vertical to the horizontal will be 26 + 12 = 38 in.

From this it can be seen that the 38-in. setting will take care of the combustion requirements *provided the rate of combustion does not exceed 25 lb. per sq.ft. of grate per hour.* Where the ratio of the grate area to the heating surface of the boiler is such as not to require this rate of combustion, the distance may be reduced accordingly.

In ordinary practice boilers should be set at a height above the dead plate not less than 0.25 of the grate length plus the height of the bridge wall. In this case 25 per cent of the grate length is $6 \times 0.25 = 1.5$ ft., or 18 in. The bridge wall being 18 in. high, then $18 + 18 = 36$. Wherever the space is available, to this is added 2 in. to take care of the required boiler slope, making 38 in. from the dead plate to the shell of the boiler. Any variation from this may be an expensive luxury or an expensive economy.

As to the betterment in performance by reducing a 48-in., or higher, setting to 38 in., it is difficult to draw a comparison, as most of the changes from higher to lower settings have been made simultaneously with other changes, such as redesign of the brickwork, and while the results obtained in each case were worth while, it would difficult to ascertain the gain contributed by reduced height. However, the writer knows of one case that may be of interest in more ways than one, and it may help incidentally to clarify some of the hazy ideas which have been, and are now being followed by some of the so-called combustion experts who persistently harp about the importance of high temperature, the chilling effect of the boiler and the horrible results following the contact of the flame and the boiler shell.

The sketches submitted are setting designs for the same boiler and can be considered as an index to the evolution of hand-fired furnaces for return-tubular boilers, each representing the prevailing idea at the time the change was made. Fig. 1 shows a full dutch-oven arch 9 in. thick extending 26 in. beyond the bridge wall. The arch is 8 ft. 6 in. long, and there is a 3-in. space between it and the shell of the boiler. The boiler is set 4 ft. at the front and 53 in. at the bridge wall from the shell to the grate.

In May, 1908, the furnace replaced a Hartford setting to prevent smoke and to improve economy. The results were not as anticipated. A boiler test showed an evaporation of only 3.84 lb. of water per pound of coal, high initial and final furnace temperatures and dense smoke after each firing for from one to two minutes. The capacity was but little over one-half of the rating. About six months later the furnace was modified as shown in Fig. 2, the significant features of modification being the addition of a deflection arch at the end of the dutch-oven arch, and the exposure of the boiler shell above the fire by removing 4 ft. from the front of the dutch-oven arch. The changes improved the smoke condition, but not to a degree to be considered satisfactory. The initial and final furnace temperatures were reduced moderately. The capacity approached rating, and an evaporation test showed 4.25 lb. of water per pound of coal of the same quality as before.

In 1914 this furnace was replaced by the fancy furnace shown in Fig. 3. A test showed an evaporation of 5.05 lb. of water per pound of coal, and the smoke condition was improved somewhat. Not being satisfied, the engineer kept on changing and another commercial furnace was installed which showed on test an evaporation of 5.17 lb. of water per pound of coal.

During the same year, on the writer's advice, the setting was changed from practically 53 in. from the grate to the shell at the bridge wall to 38 in. and the brickwork was redesigned, as shown in Fig. 4. A test with the same quality of coal used with the other furnaces showed an evaporation of 7.78 lb. of water per pound of coal. In a seven-day test the evaporation was 7.07 lb. of water per pound of coal. The chimney never shows dense smoke if the boiler is properly fired.

In this case it is difficult to say how much credit for the improvement in evaporation is due to decreasing the distance from the shell of the boiler to the grate or how much is due to the brickwork rearrangement, but there is no question that it made a tangible contribution to the final results.

The Solid Injection Oil Engine

The air compressor, be it a direct-connected or a separate unit, furnishes a large percentage of the Diesel-engine troubles. The pressures and conditions under which it operates are such that lubrication is difficult; valves often leak and packing troubles are always present. Furthermore, since considerable quantities of air are employed in the injection of the fuel charge, the power demands of the compressor range from 6 to 10 per cent of the horsepower developed in the engine. Many Diesel designers have attempted to eliminate the compressor, but with little success. Where the engine is operating on the Diesel cycle, the injection of oil occurs over a considerable period of the power stroke, and it is necessary to have some means whereby the pressure in the fuel-oil lines can be kept constant during the period of injection.

The Vickers Co., of England, several years ago abandoned the air blast on their Diesels and now make use of a fuel-injection system having a flattened steel tube to maintain the oil pressure. This design apparently is very successful since many Vickers Diesels are in daily service in the British navy and in the merchant marine.

The explosive, or constant-volume, oil engine does not require a constant oil-line pressure nor the somewhat complicated fuel-valve mechanism of the Diesel, and it is to this type of engine that the solid injection principle is most adaptable. The one feature with the solid injection engine that requires the most careful designing is the atomizer, or injection nozzle. Since there is no air blast to break up the fuel, the atomizer must do this mechanically. In fact, the oil must be atomized in a more perfect manner than necessary with the air-injection engine. Furthermore, the nozzle must handle the oil without the dribbling effect so prevalent in hot-bulb designs.

In the Diesel engine it has been customary to employ a compression pressure ranging from 450 to 600 lb. per sq.in. Those engineers accustomed to these pressures are under the impression that with the lower pressures encountered in the explosive engine the temperature will be entirely too low to cause auto-ignition. It then appears unreasonable to operate an engine having a compression pressure of 200 to 300 lb. without a hot-bulb or other ignition device. The following explanation is given with the idea of clearing up this question.

It has been proved that a fuel will ignite at a temperature well below 800 deg F. provided it is atomized or broken up to allow each minute oil particle to be in contact with the necessary amount of air. It is ap-

parent that two things are required—thorough atomization and proper temperature. Fig. 1 is a curve showing the relation of temperature and pressure where the compression is adiabatic. This curve is based on the equation,

$$\frac{T_1}{T_2} = \left(\frac{P_1}{P_2}\right)^{1-\frac{1}{n}}$$

T_1, the temperature at the beginning of compression, is here assumed to be 212 deg. F. When the engine is warmed up, this value is about correct, although on starting cold, T_1 will be somewhat lower. The exponent n is assumed to be 1.35 instead of 1.41, with the intention of making allowance for the loss to the cylinder walls during compression.

The temperature with 300 lb. final compression pressure is approximately 1,050 deg. F. This is amply high to ignite any of the fuel oils. The Diesel engine, with its large radiating surface relative to its compression volume, experiences a loss of temperature that is much greater than in the case of the solid-injection engine having a combustion chamber with a large volume and a small radiating surface. It is quite likely that the chilling effect of the expanding air blast in the Diesel causes a drop of at least 150 deg. F. in the temperature of the air and oil. As a practical example of the ability to operate at 300 lb., many operators are running old Diesels with a still lower compression.

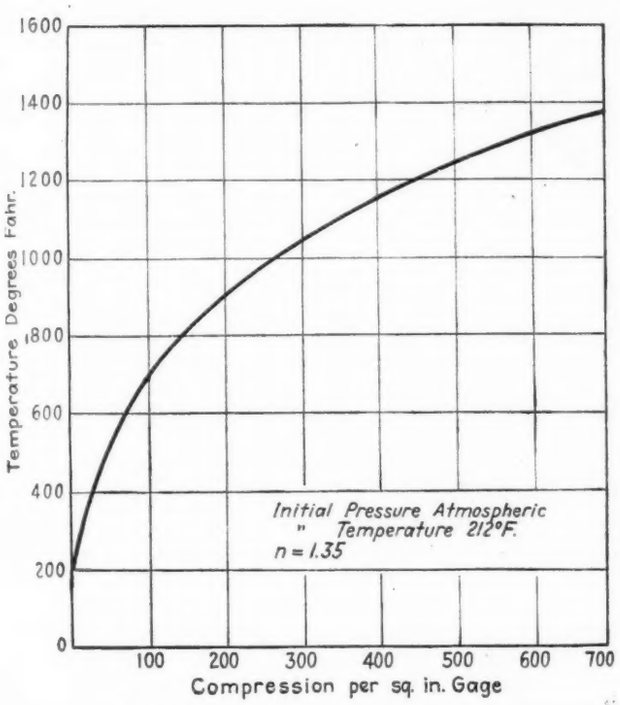


FIG. 1. CURVE SHOWING RELATION OF TEMPERATURE AND PRESSURE WHERE COMPRESSION IS ADIABATIC

As has been stated, the curve in Fig. 1 is based on an initial air temperature of 212 deg. F. On starting a cold engine, this value is much too high; if there is no throttling of the air, it should be around 70 deg. F. This would give a final temperature of about 725 deg. F., which is sufficient to ignite a well-atomized fuel charge, although the first few explosions will probably smoke badly. To secure thorough atomization and ignition, it is necessary that the oil be broken up without any part striking the relatively cold walls of the combustion chamber. This has led to various designs of combustion chambers as well as atomizing devices.

In this discussion no consideration has been given to the effect the injected oil has on increasing the pressure and temperature of the mixture in the combustion chamber or to the time element as applied to the period of vaporization of the oil. There is no doubt that both these factors have marked influences on the action of the engine.

The timing of the injection of the fuel varies in different makes of engines from 40 deg. to 6 deg. ahead of outer dead center. The operator of a Diesel knows from experience that an injection point much over 7 deg. ahead of dead center will produce marked preignition; in the hot-bulb engine an injection point of 30 deg. will cause severe pounding unless water injection is employed. In the solid-injection oil engine it has been found that the timing is largely dependent on the compression carried. If the compression is as low as 200 lb., as in the Price engine, the injection must be earlier than 30 deg. to give ample time for the vaporization of the oil, while with 300 lb. pressure, as with the De La Vergne S. I. engine, the injection is not over 6 deg. To avoid danger of preignition at early injection periods, a combustion chamber is placed in the head. The oil is injected into this space where it mixes with the air. Since the major part of the air charge is contained within the cylinder, the amount of air in the combustion chamber is not sufficient to produce ignition even with a sufficiently high temperature. Ignition can occur only when the moving piston forces the main air charge into the combustion space.

The fuel consumption per brake horsepower is low; in many cases it equals the best Diesel results. Since the compression is much lower than with the Diesel engine, the thermal efficiency based on indicated horsepower is not as good as with the latter engine. The extremely high mechanical efficiency, due to elimination of the air compressor and lower frictional loss, is responsible for the excellent fuel economy.

Some Boiler Statistics from "The Locomotive"

SUMMARY OF INSPECTOR'S WORK FOR 1919

Total number of boilers examined	371,285
Number inspected internally	160,847
Number inspected by hydrostatic pressure	9,043
Number of boilers found to be uninsurable	1,042

SUMMARY OF DEFECTS DISCOVERED

Nature of Defect	Whole Number	Dangerous
Cases of sediment or loose scale	31,599	1,783
Cases of adhering scale	47,284	1,907
Cases of grooving	2,393	271
Cases of internal corrosion	21,201	817
Cases of external corrosion	11,260	955
Cases of defective bracing	1,173	230
Cases of defective staybolting	2,428	493
Settings defective	9,423	836
Fractured plates and heads	3,473	487
Burned plates	4,836	518
Laminated plates	338	27
Cases of defective riveting	1,443	324
Cases of leakage around tubes	13,318	1,226
Cases of defective tubes or flues	19,700	6,353
Cases of leakage at seams	5,738	413
Water gages defective	4,158	789
Blowoffs defective	5,325	1,488
Cases of low water	421	149
Safety valves overloaded	1,134	289
Safety valves defective	2,077	374
Pressure gages defective	7,332	628
Boilers without pressure gages	634	82
Miscellaneous defects	5,588	664
Total	202,276	20,603

Note that more than a thousand boilers were found so dangerous as to be considered too great a risk—and this is the number found by but one company.

Electric Elevator Machinery—Brake Adjustments

Precautions To Be Observed in Coupling Motor to Elevator Machine — How To Make Brake Adjustments Properly—How To Reline Brake Shoes and Get the Leather To Make a Good Fit

By M. A. MYERS
Electrical Engineer, The Maintenance Co., New York City

THE connecting link between the motor and a modern elevator machine is the coupling, which is actually a combined coupling and brake pulley. Fig. 2 shows a section through a typical coupling. The fit of the shafts in the coupling must be excellent, the keyways well cut and the keys a tight fit. Owing to the constant reversals, starts and stops, loose keys and keyways will be so battered in a comparatively short time that a shop job will be required to repair the damage.

The brake on electric elevators may be either a leather-lined band of sheet steel, or as is now more generally practiced, two leather-lined cast-iron shoes. Occasionally, in some of the older machines wood lagging is found instead of leather. The brake is opened and held open by an electric solenoid or magnet and is set against the brake pulley when the current is switched off, by means of a spiral spring or springs, although occasionally a weight-and-lever device is used.

One modern type of brake, as used on a Wheeler McDowell elevator machine, is shown in Fig. 1. When the solenoid *F* is energized, the plunger *G* is pulled up and raises lever *H*. This action lifts the top shoe and lowers the bottom one by means of the links *K* and *K*, which are made adjustable by turnbuckles. Side movement of the shoes *S* and *S* is prevented by the guides *E* and *E* which are an integral part of the supporting frame. When the solenoid is de-energized, the shoes are forced against the pulley by the spiral springs *J* and *J*, the tension of which is adjusted by the nuts *N* on the through-rod.

The adjustments of elevator brakes may be easily and quickly made or may be a slow and tedious job, according to the style of brake and the local conditions. An improperly counterweighted car adds to the difficulties of brake setting, and this is particularly true where the car is heavier than the weights. The prerequisite for satisfactory brake adjustment is to have the shoes to open as little as possible without rubbing the brake wheels when the brake is released. An opening that will permit the insertion of an ordinary sheet of writing paper between the shoes and brake wheel is sufficient. This will allow the shoes to set quickly and smoothly and minimize any tendency to rebound. The remaining adjustment may be then made by means of adjusting spring tension or weight leverage.

A properly counterweighted equipment is one that is over-counterweighted by about one-third the full-load capacity of the car. Then as the car is loaded, it approaches an even balance and ordinarily makes the majority of its runs under this approximately balanced condition; therefore, strain on the brake is evenly divided on the up and down motion. When the car is loaded up to two-thirds of the capacity, the original no-load condition is simply reversed in that the one-third overbalance is in the car instead of the counterweights. Then there is only a one-third additional load on the car over the counterweights to provide for, making it possible in the ordinary brake setting, as already described, to insure a reasonably easy stop under all conditions of loading.

When the car is heavier than the counterweights to start with, the brake will have more work to perform on the down motion than on the up, and this condition never reverses. As the load on the car is increased, the work for the brake on the down motion is increased, while on the up motion it is practically zero, except to prevent the car from starting downward again after it comes to a stop. If the brake is adjusted to work smoothly on the down motion, it will very likely cause a severe jar to the car and machinery on the up motion. About the best that can be done in some cases is to strike a compromise. However, where the construction of the brake will allow, adjusting one shoe closer to the pulley than the other or giving one shoe greater tension than the

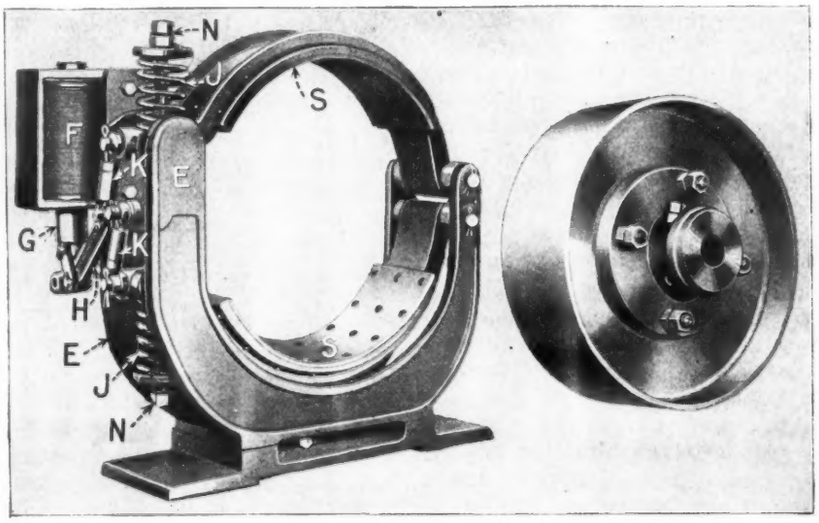


FIG. 1. SHOWING ELECTRIC ELEVATOR BRAKE MECHANISM

other, or both, will help materially in making a smooth stop. The explanation for this will be found in Fig. 3. With the brake pulley running clockwise, as shown by the curved arrow, in which case most cars will be on the up motion, the rotation of the pulley when the brake sets will tend to make the top shoe grip tighter and will tend to throw off the bottom shoe, as indicated by the short arrows. Reverse the motion and the

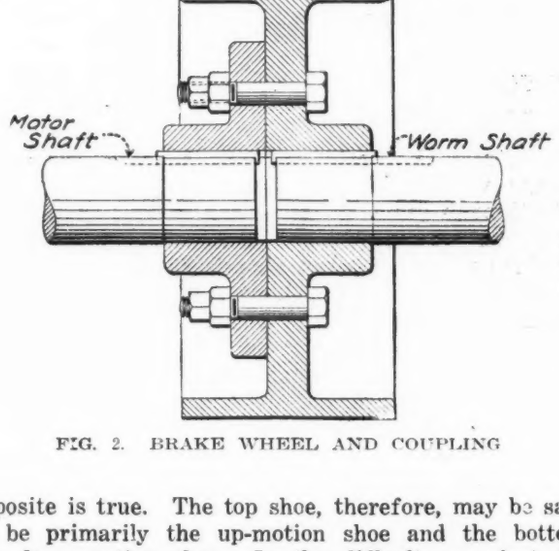


FIG. 2. BRAKE WHEEL AND COUPLING

opposite is true. The top shoe, therefore, may be said to be primarily the up-motion shoe and the bottom the down-motion shoe. In the difficult case just described, surprising results may sometimes be obtained by adjusting the bottom or down-motion shoe to do most of the work. Where the brake has vertical shoes, merely figure out the up- and the down-motion shoes from the direction of rotation and the location of the hinge pins. This principle of adjustment need not necessarily be applied to exceptional cases only.

Dynamic Braking for Elevators

Some types of brakes have adjustable stops to govern the amount of opening of one or both shoes. In all cases a few moments' study will show the similarity of action but with different details. The foregoing discussion takes no account of dynamic braking, which is now considerably used, especially for high-speed cars, to assist the mechanical brake. Dynamic braking consists of connecting a resistance across the armature terminals the instant the operating current is switched off, with the fields in a greater or less state of excitation. The motor then becomes a generator sending current for an instant, of approximately the initial starting inrush value, and dying down to zero as the car comes to rest, through the resistance. This dynamic load on the motor acts to bring it to a stop and is of great assistance to the mechanical brake. The amount of dynamic braking can be adjusted by adjusting the dynamic resistance and also, where the system of control permits, by adjusting the field strength. On some types of controllers two or three dynamic braking switches are used to reduce the dynamic resistance as the motor comes to a stop.

If for any reason the brake must be removed, take the precaution to land the weights in the pit by placing a timber under them and inching the car up until the weights land. If it happens that the car is heavier than the weights, it must of course be landed instead of the latter. This condition can usually be determined by holding the brake open so that it can be quickly applied and then turning the brake pulley and noting the direction in which it tends to continue to rotate. Where convenient, the drum is sometimes blocked instead of landing the weights or car. These precautions are to prevent runaways, which sometimes result in disaster.

Oil Sometimes Causes Trouble

Trouble with brakes may arise from oil creeping from the motor bearing or gear-case stuffing box to the brake pulley and impregnating the leathers. When the brake is cold, this oil will be gummy and the braking action likely to be harsh. As the brake warms up, the oil will become thin, and sliding may ensue, The remedy will be to remove the shoes, wash the leathers thoroughly with gasoline or scrape with glass, or apply both remedies. Sometimes fuller's earth or whiting is rubbed into the leathers to absorb the oil, after which they are scraped. On the other hand, when the leathers become dry and brittle, they should be treated with a good leather dressing such as neatsfoot oil. Wearing of the hinge pins, link pins and bores will increase brake-adjustment difficulties. When this occurs, the holes can be rebored and bushed and new pins substituted.

The brake leathers are fastened to the shoes or bands by means of copper rivets, the heads of which are countersunk into the leather. Before the leather is worn so thin as to allow the rivet heads to rub, the brake should be relined. The leather is usually about one-quarter inch in thickness; the proper thickness for any case can be determined by measuring the brake-pulley diameter and the diameter to which the shoes are bored.

To renew the leathers without special equipment, remove the old leather and rivets, cut the new lining to size and clamp it to the shoes at each end by means

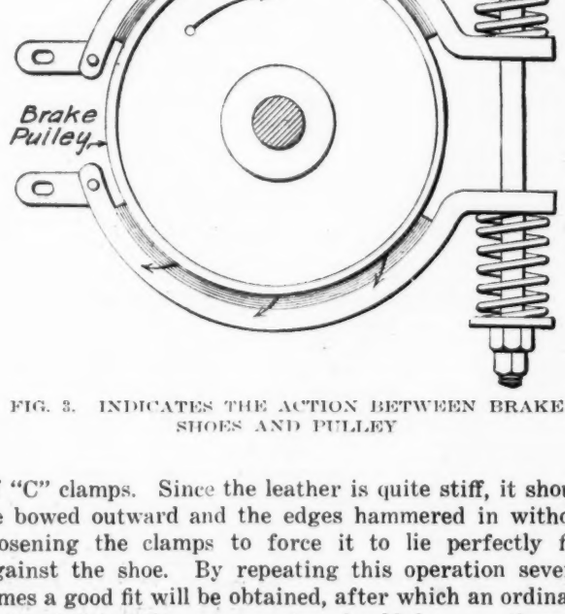


FIG. 3. INDICATES THE ACTION BETWEEN BRAKE SHOES AND PULLEY

of "C" clamps. Since the leather is quite stiff, it should be bowed outward and the edges hammered in without loosening the clamps to force it to lie perfectly flat against the shoe. By repeating this operation several times a good fit will be obtained, after which an ordinary twist drill of the proper size should be run through the holes in the shoe and at the same time through the leather, holding the latter against a wood block. A

special flat-ground countersink drill the size of the rivet heads, with a center guide, is then used to countersink the holes in the leather to at least one-half the thickness of the lining. The riveting is then simple; No. 7 rivets are usually employed. Care must be taken that the leather hugs the shoe the entire surface to make sure. Sometimes it is desirable to place a leather lining on an old wood-lagged brake. The wood lagging should be bored to the correct diameter, after which the leather may be fastened either by shoemaker's wooden pegs or by flat-head wood screws, countersinking the heads similarly to the rivets. In either case it is well to fasten the ends of the leather with flat-head stove bolts, extending through the old lagging and the iron shoe.

Our Water Powers—Fallacies, Facts and Possibilities

Rebuilding Small Plants as Desirable as Making New Developments

By EARL STAFFORD
With John F. Vaughn, Engineers, Boston

HOW many of us have a clear understanding of the future of our water powers, their extent, the expenditure necessary before their energy may be utilized and their value to the country when developed? Extravagant statements by enthusiasts have added to a popular belief that water power is practically inexhaustible and virtually free, while repeated use of the term "white coal" has created the impression that when coal and other natural fuel supplies are gone, hydro-electric developments will furnish the greater part of our light, heat and power. It is the purpose of this article to show the error in such beliefs by giving a better general idea of the limits and possibilities of water power, and also to show how the manufacturer owning a water-power plant may, with profit to himself, help to conserve the fast disappearing fuel of the United States.

Water power can never be exhausted by use because it comes from the rain-water which, when evaporated from the ocean, runs back over the falls and rapids of the rivers. On the other hand, the amount available in any one year has definite limits which may be determined by engineering investigation, and although the supply is continuous the volume of power is surely far from unlimited. One of our leading engineers, Dr. Steinmetz, of the General Electric Co., in a comprehensive analysis of the water resources of the United States, has shown that if all rivers could be dammed throughout their length and developed for power, we would not get the power equivalent of the coal mined annually in this country. The impossibility of completely substituting water power for coal will thus be seen, and as the requirements of our industries are increasing at an enormous rate, the discrepancy between the demand and this supply will be even more apparent as the years go on.

Water-Power Development Costs Money

Another idea often put forth is that water power is unlimited and that vast amounts may be had for practically nothing. This is far from true, for although water, the raw material, is free, plants built to produce hydro-electric power involve heavy expenditures. Modern large-scale developments require investment for power houses and equipment, and for the cost of land inundated by dams, with resulting interest charges that are equal to a large part of the fuel bill of a steam-power station doing the same work. In most sections of the country, however, there are still many untouched water-power sites that may be developed to produce power cheaper than it can be obtained from coal. As demonstrated by early ventures, however, success in water-power development of any magnitude can come only through sound financing and careful engineering. At present we can choose those most advantageous, but the time will come when almost all water-power possibilities must be developed, even at great cost, in order to conserve fuel for human needs.

It has been well said that the most daring experiment ever attempted by the human race occurred when man left the torrid zone for climates where fuel is an absolute necessity for preserving human life. Cheap and abundant fuel has so far made the experiment a success. That it may continue to be so in the face of the depletion of fuel resources is a problem that gives much concern. The solution undoubtedly lies in securing additional sources of heat supply. In this connection some of us have the hazy notion that we can use electricity from water power for heating our homes. This is indeed a fallacy. Electricity for heating a home would cost at least ten times as much as coal for the same purposes, and the demand would exceed the supply long before even those who could afford to pay for it could be provided for. We must, therefore, continue to use fuel for heat, but can employ water power for lighting and industrial use, assisted when necessary by power from steam stations. It is a patriotic duty, then, to be saving of natural fuel resources for coming generations, that they may not be able to convict this generation of robbing them.

Conservation Generally Recognized as Necessary

Attempts to adopt a general conservation policy have already been made by some nations. In England the government is studying schemes for mammoth steam plants located by districts so that power may be distributed electrically and thus eliminate the waste of scattered small producers. Canada is alert, and through commissions, the various provinces are not only mapping out a progressive policy but also have built large hydraulic plants and transmission systems. In this country also, schemes have been proposed for private capital to build steam plants at the mouths of the mines, connected through a network of transmission lines with power developments on the large rivers. These proposals are not visionary and are sure to materialize within the lives of the present generation.

One of the more economical ways of obtaining power is by rebuilding the obsolete under-developed or poorly planned hydraulic plants that were constructed years ago to meet the moderate demands of our early manufacturers. A small water-power plant, for instance, may be so

outgrown by the mill of which it is a part that its value seems insignificant. While the rest of the manufacturing plant has become modernized, the water-power equipment, except for the occasional replacement of worn parts, has been left as originally built. Perhaps the amount of power obtained from it is unknown, and very likely thought to be several times as great as tests would show. Possibilities for revamping or redevelopment in such cases are comparatively great, and frequently 100 per cent more power is obtainable. The owner of such a plant may reason that the gain by rebuilding is insignificant when compared with the rest of his manufacturing costs. This may be true, but the saving in power cost that is possible by increasing the output of even a small hydraulic plant may be an appreciable part of the net earnings of the entire factory which it serves. In general it may be stated that every ten horsepower that can be added to the output of the plant by the use of water power will save annually the mining and transporting of a car of coal.

How Reconstruction May Increase Output

As illustrations of the ways in which more power may be secured through reconstruction of an old plant, the following may be mentioned:

1. New waterwheels of modern type will deliver more power from the same water.
2. Elimination of gears and countershafting by direct-connected electrical generators, from which the power is distributed electrically, will often add to the power previously obtained.
3. By enlarging and changing the water passages to and from the wheel case, according to our better knowledge of hydraulics, the power losses caused by friction in the flowing water will be materially reduced.
4. By general improvements of the entire hydraulic layout through stopping leaks in dams and bulkheads and making miscellaneous repairs that an engineering examination would show to be advantageous, much wasted water may be saved.
5. Changing the top of the dam or the flashboards so as to provide at all times a maximum level of the headwater will often increase the available head. When mills were first built, their power requirements were small and no attempt was made to secure all the head or fall possible for the hydraulic plant. New ways of discharging the flood water open up unexpected possibilities along these lines.
6. Improvement in the millpond or in small near-by storage reservoirs so that the night flow of the river may be stored for day use, will increase the water available.

When, as in the case of many mills, there is a steam plant working in conjunction with the hydraulic plant, the combined saving by rebuilding the water power may be especially advantageous.

Old plants, considering the quantity of power that they furnish, are expensive to operate and to maintain. Modern plants, on the other hand, because of the extreme simplicity of their apparatus, require little care and almost no repairs and replacements, for elimination of gears and bearings has done away with practically all the old troubles. Automatic or semi-automatic plants which operate night and day without an attendant and with only occasional inspection are among recent improvements. Automatic devices control the power output of these plants according to the water available or the demand for power, as the case may be. When located some distance from the mill, electrical control switches and indicating instruments may be provided which make it unnecessary to go to the power station when starting or shutting down.

If the power produced by a small plant is at times more than can be utilized, a new source of revenue lies in connecting with the transmission system of public-utility light and power companies. The output from reliable hydro-units, however small, is often sought by local power companies, as it gives a reserve for emergency. If a manufacturing plant is purchasing part of its power, this expense may be materially reduced by selling to the power company the spare output of the plant during the night. Revenue from such sale is practically clear profit as it comes from water that otherwise would go to waste over the dam. A case in mind is that of a small low-head plant thought to be useless and at first abandoned because the mill, which had burned, was rebuilt at some distance. The rehabilitated power plant with a short transmission line now furnishes about two-thirds of all the power the mill requires, and during the greater part of the year sells part of its output to the local power company at a reduced rate, paying the owner a handsome profit on his investment. The financial return, however, is not necessarily the most important consideration, as was demonstrated during the war when the Fuel Administration found it necessary to close on one day per week all factories not operated by water power. By obtaining the maximum output from his hydraulic plant, the individual manufacturer may safeguard his own interests and by helping to save coal further a policy of conservation that will become increasingly important in America's progress.

Conservation a Present, Not a Future Problem

To those who say that conservation is a problem of the future and that later generations must look out for themselves, we answer that the time has already come when this generation must look carefully to its own future. The cheapest and most readily obtainable of our natural resources have been used, and the rich homestead lands that attracted European labor have been settled. We are fast approaching the labor and natural economic conditions that prevail in other countries.

The turn of the road for us came with the great changes in world economic conditions caused by the war. We are being forced into active trade competition with European nations which make conservation a science. To retain the lead that the war has given us, we must study to reduce extravagance and to eliminate waste, in order that when the period of lower prices comes we shall be prepared to meet it. Development of additional water power will release coal-mining labor for other work and will lighten the heavy burden imposed upon the railroads, which results for the individual manufacturer in higher fuel prices and from which the nation as a whole suffers through clogging of the channels of transportation.

In planning the big things, let us not overlook the small possibilities—great in the aggregate—that lie around us, at the power sites selected by our forefathers for their mills, for the improvement in them which is commercially possible will on the whole double the power that they now contribute.

Two Indirect Methods of Finding the Weight of Ammonia in Circulation in Compression Refrigeration

By J. W. GAVETT, Jr.

MANY different methods have been used to determine the weight of ammonia in circulation in compression refrigerating systems. Among the direct mechanical methods are the use of meters of various types and the placing of tanks, mounted on scales, between the condsenser and the receiver. It is evident that these entail the installation of special and expensive apparatus and add to the already large number of valves and joints that must be kept tight.

It is proposed here to outline two non-mechanical methods of computing the weight, which require little in the way of apparatus beyond the plant proper. They will be considered separately, the shorter and simpler, which might be termed the pressure-volume method, being discussed first. The necessary apparatus additional to the plant includes thermometers to read discharge temperature at the compressor cylinders, a revolution counter (usually installed with the plant) and an indicator with which to take indicator diagrams from the compressor cylinders. The charts of the properties of ammonia, which accompany this discussion, complete the necessary equipment. These charts were recently plotted by the writer from the tables published in 1917 by Messrs. Keyes and Brownlee ("Thermodynamic Properties of Ammonia," John Wiley & Sons, Inc.), which are the latest and regarded by the present writer to be the most accurate source of information available.

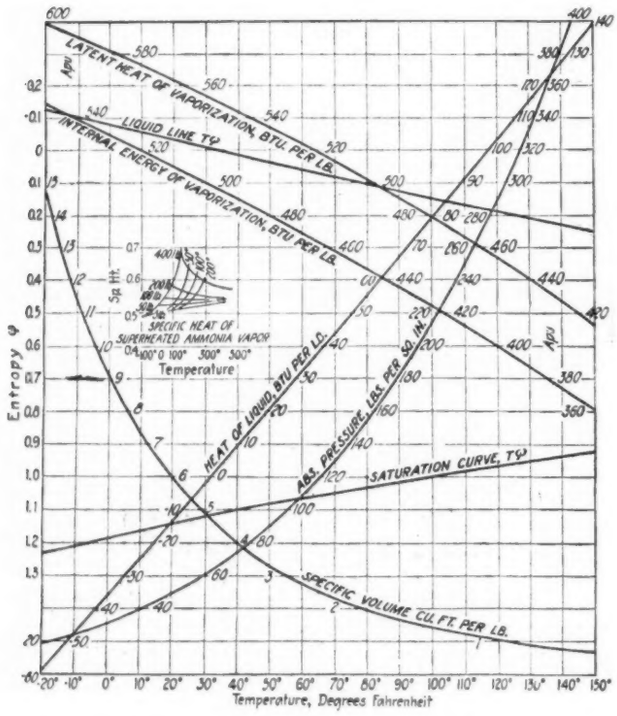

LATENT HEAT OF VAPORIZATION, BTU. PER LB.
LIQUID LINE T-S
INTERNAL ENERGY OF VAPORIZATION, BTU. PER LB.
SPECIFIC HEAT OF SUPERHEATED AMMONIA VAPOR
Temperature
HEAT OF LIQUID, BTU PER LB.
ABS. PRESSURE, LBS. PER SQ. IN.
SATURATION CURVE, T-S
SPECIFIC VOLUME CU. FT. PER LB.
Entropy Φ
Temperature, Degrees Fahrenheit

FIG. 1. THERMODYNAMIC PROPERTIES OF AMMONIA

The scale to the left of the chart applies, of course, only to the liquid line and saturation curve. (Plotted from tables of Keyes and Brownlee.)

A brief explanation of the charts is advisable at this point. The various curves of Fig. 1 relate to liquid ammonia and to wet and saturated ammonia vapor, but do not enter the superheat field. On this chart the only curve that applies to the present problem is that of absolute pressures vs. temperatures. This curve is, of course, a means of determining the boiling points of liquid ammonia at various absolute pressures or vice versa.

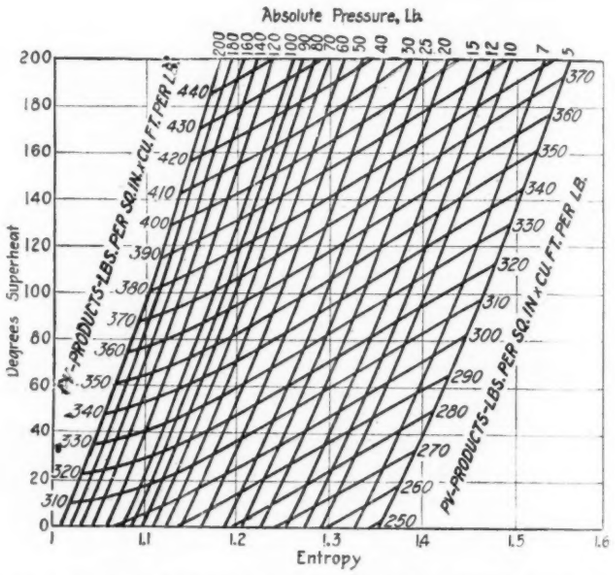


FIG. 2. PROPERTIES OF SUPERHEATED AMMONIA VAPOR

Fig. 2 deals with superheated ammonia vapor and is fundamentally a temperature-entropy chart in which degrees of superheat have been substituted for temperature. Superimposed on the temperature-entropy coordinates are two additional sets of lines, one of constant absolute pressures and one of constant pressure-volume (PV) products (pressure in lb. per sq. in. $\times$ volume in cu.ft. per lb.). The advantage of this arrangement will become apparent as the discussion proceeds.

The demonstration and calculations will be made from an actual indicator diagram and actual data taken from a test run on the 15-ton York plant at Cornell University. To obtain maximum accuracy, the data should be averaged from readings and diagrams taken at intervals throughout a run of considerable length. For simplicity of demonstration one card only is used in this discussion, although the remainder of the data has been averaged from a series of readings. Fig. 3 is an exact copy of a diagram taken from one cylinder of

the two-cylinder compressor. The additional necessary data are as follows:

Barometric pressure in mercury, 29.95 in., equals	14.7 lb. per sq.in.
Discharge pressure, gage	68.0 lb. per sq.in.
Discharge pressure, absolute	82.7 lb. per sq.in.
Discharge temperature, deg. F	138.5
Dimensions of compressor cylinder	8x12 in.
Piston displacement per revolution	0.443 cu.ft.
Scale of indicator spring	60 lb.
Revolutions per minute of compressor	52.8

The first step is to find the *PV* production of *one pound* of ammonia at discharge conditions; that is, on the high-pressure side of the system. From Fig. 1 the

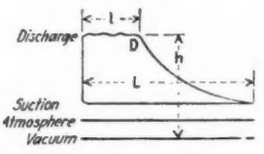


FIG. 3. REPRODUCTION OF DIAGRAM FROM A 15-TON COMPRESSOR

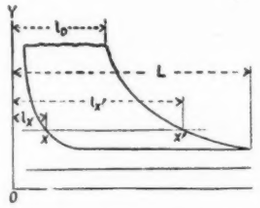


FIG. 4. DIAGRAM SHOWING RE-EXPANSION EXAGGERATED

boiling point corresponding to an absolute pressure of 82.7 lb. per sq.in. is 45.5 deg. Thus the superheat at discharge is 138.5 — 45.5 = 93 deg. Turning now to Fig. 2 and following the horizontal line of constant superheat of 93 deg. to its intersection with the constant pressure line of 82.7 lb., a *PV* product value of 362 is determined.

The remainder of the procedure is based on measurements of the diagram taken at point *D* (Fig. 3), which is the point where discharge pressure is reached and ammonia begins to leave the cylinder.

The actual volume at *D* is $\frac{l}{L} \times$ 0.443 cu.ft., in this case $\frac{0.77}{2.29} \times 0.443 = 0.149$ cu.ft.

The diagram, Fig. 3, shows clearly that there is no re-expansion in the cylinders; that is, there is no clearance volume. Should the diagram show re-expansion, as in Fig. 4 (exaggerated), the clearance volume must be determined and allowed for. The clearance line *OY* (Fig. 4) may be calculated from direct measurements of the cylinder or may be graphically determined by various methods described in books dealing with steam-engine-indicator diagrams. To determine the allowance to be made, draw any line *xx'* parallel to the vacuum line and intersecting both the re-expansion line and the compression line. The total volume in the cylinder is $\frac{l_x}{L} \times$ (piston displacement + clearance volume), but of this the proportion $\frac{l_x}{l_{x'}}$ is due to clearance and will not be discharged at the end of the stroke. This ratio may safely be assumed to hold for the entire re-expansion line, so the true volume to be considered at point *D* is $\left(\frac{l_D}{L} \times \frac{l_x}{l_{x'}}\right) \times$ (piston displacement + clearance volume).

The absolute pressure at *D*, Fig. 3, is $h \times 60$, or $1.39 \times 60 = 83.4$ lb. per sq.in. The actual *PV* product is therefore $0.149 \times 83.4 = 12.4$.

The weight of ammonia in the cylinder is thus $\frac{PV \text{ actual}}{PV \text{ for one lb.}}$, or $\frac{12.4}{362} = 0.0342$ lb. The weight per hour follows by multiplying by the r.p.m., or revolutions per minute, and by 60; that is, $0.0342 \times 52.8 \times 60 = 109$ lb. per hr., approximately.

A similar process is applied to the other cylinder, and the sum of the two results gives the total weight in circulation per hour. In this case the total was 236 lb.

This method may be applied only when the vapor is superheated at discharge, but as this is almost universally the case in present practice, its application will not be greatly limited on that account.

It will be noticed that this procedure is based on the assumption that any change that takes place in the vapor as it passes through the discharge valve has but a negligible effect on the value of the *PV* product. This passage through the valve is evidently a wire-drawing effect and takes place at constant heat. A critical analysis of the process on this basis, using

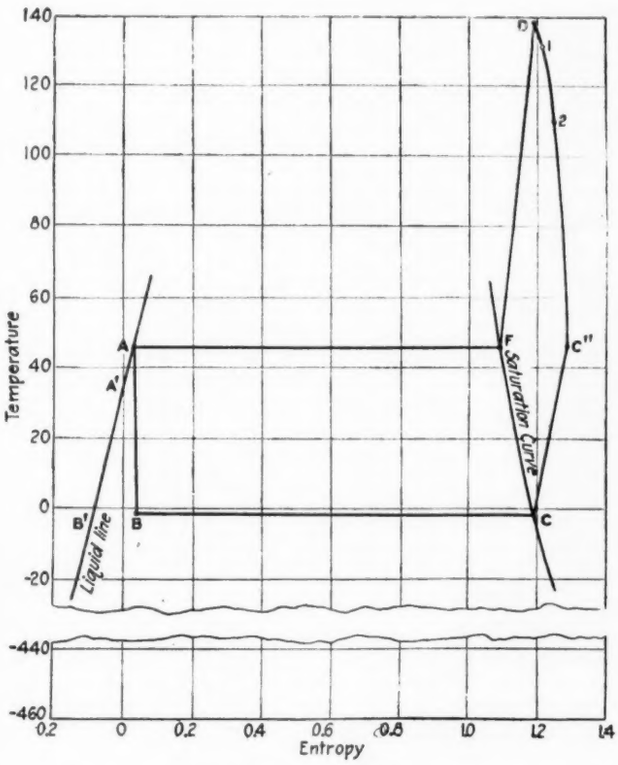


FIG. 5. TEMPERATURE-ENTROPY DIAGRAM OF AMMONIA CYCLE

Since entropy is a function of heat and absolute temperature, the temperature scale must read from absolute zero, or 460 deg. F. For the purpose of this discussion the temperature scale is broken to avoid unnecessary size of the chart.

values from the tables previously mentioned, shows that this wiredrawing has no perceptible effect on the *PV* product.

As for other sources of error, analysis shows that discrepancies in pressure due to inaccuracy of the gage or in reading will induce an error in the *PV* value of 10 per cent of the relative error of the pressure determination. In other words, an error of 1 per cent in pressure will cause an error of $\frac{1}{10}$ of 1 per cent in the *PV* value.

Similarly, an error of 1 deg. in the measurement of discharge temperature will produce an error of $\frac{18}{100}$ of 1 per cent in the PV value. These errors should be negligible.

The Temperature-Entropy Method Explained

The second method to be discussed may best be designated as the temperature-entropy or $T\phi$ method. This system of calculation requires additional thermometers to make temperature determinations as listed below and also another pressure measurement, that of the low pressure or suction side of the system. In this case we had:

Suction pressure, gage	14.5 lb. per sq.in.
Suction pressure, absolute	29.2 lb. per sq.in.
Temperature of ammonia into condenser	112 deg. F.
Temperature of ammonia out of condenser	46.5 deg. F.

Since entropy (ϕ) is by definition the dimensions of heat divided by *absolute* temperature, an area on a $T\phi$ chart represents heat. Heat may be expressed as work if multiplied by 778, the mechanical equivalent of one B.t.u. These are the fundamental conceptions on which the temperature-entropy ($T\phi$) method is based.

Fig. 5 shows the $T\phi$ diagram for *one pound* of ammonia in the case under discussion. The construction of this diagram from the data available will now be traced. The first step is the plotting of the liquid line and saturation curve. These may be taken directly from Fig. 1, which, when turned left side down, contains a $T\phi$ chart. Let us start with the liquid ammonia emerging from the condenser at condenser (discharge) pressure (82.7 lb.), for which the corresponding boiling temperature is 45.5 deg. F. This gives point A on the liquid line. In the present case there is practically no supercooling, the temperature of the ammonia coming out of the condenser being 45 deg. In case supercooling occurs, it will be shown by some point A' on the liquid line. This makes no difference in the area of the diagram, since the next stage of the ammonia cycle is reheating along the liquid line back to point A. This heat will usually be taken up from the storage system or piping between the condenser and the expansion valve.

The ammonia now expands freely at constant heat through the expansion valve to suction pressure, 29.2 lb. abs. The boiling temperature corresponding to this pressure (—2 deg. F. from Fig. 1) locates the level of line BC, along which vaporization takes place, but does not locate point B. We know that some vaporization has taken place and that it is expressed graphically by the distance $B'B$, the value of which may be found by equating the heat contents at points A and B. The sensible heat of the liquid qA (at point A) is, from Fig. 1, 15.5 B.t.u. per lb. At B the heat is made up of two parts, first the heat of the liquid at —2 deg. F. and second a ratio $\frac{B'B}{B'C}$ of the heat of vaporization r, at —2 deg. F. From Fig. 1 r_B is 582 B.t.u. and q_B is —39 deg. F. Letting $\frac{B'B}{B'C} = x$, we can write

$$q_A = q_B + xr_B \text{ or } x = \frac{q_A - q_B}{r_B}.$$

Substituting, we find $x = 0.0935$; or, in other words, the quality of the ammonia vapor at point B is 9.35 per cent. Next, multiplying the length of the line $B'C$ (in any units) by 0.0935, we get the length $B'B$, thus locating point B.

From B the vaporization continues along line BC, the heat of vaporization being taken from the brine or other substance, which is to be cooled. At point C the vaporization is complete and superheating begins. The line CC'' is evidently a constant-pressure line, as the ammonia is still on the suction or low-pressure side of the system. It is sensibly a straight line and can be drawn as such without appreciable error. Its exact shape may be plotted with data taken from Fig. 2. At point C'' the ammonia enters the compressor. The point is located as follows: From the data, suction temperature is 46.5 deg. F., but the boiling point at suction pressure is —2 deg. F. Thus we have 46.5 — (—2) = 48.5 deg. superheat at 29.2 lb. per sq.in. From Fig. 2 we can read the entropy at point C'' as 1.285. Plotting this against the temperature (46.5 deg. F.), we locate point C''.

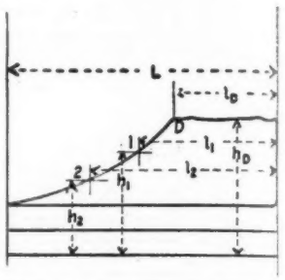


FIG. 6. SHOWING MEASUREMENTS FOR TRANSFERRING COMPRESSION LINE TO TEMPERATURE - ENTROPY DIAGRAM

A similar process applied to discharge conditions locates point D, but the shape of the line $C''D$, which corresponds to the compression line on the indicator diagram, must be obtained from that source. As before, one diagram only will be used for demonstration and but two intermediate points will be plotted. Fig. 6 shows the actual diagram and indicates the method of making the necessary measurements. For accuracy a series of results should be averaged and at least four intermediate points plotted.

This process may best be shown by means of a table with some accompanying explanation.

Points	D	1	2
$l/L \times 0.443$= actual volume	$\frac{1.12}{2.92} \times 0.443 = 0.17$	$\frac{1.49}{2.92} \times 0.443 = 0.226$	$\frac{2.02}{2.92} \times 0.443 = 0.306$
$h \times 60$ = absolute pressure	$1.44 \times 60 = 86.2$	$1.06 \times 60 = 64.5$	$0.765 \times 60 = 45.9$
Actual PV product	$0.17 \times 86.2 = 14.6$	$0.226 \times 64.5 = 14.55$	$0.306 \times 45.9 = 14.05$

The PV product for one pound at discharge conditions has been determined as 362. Then the PV values for one pound at points 1 and 2 must bear the same relation to 362 as the actual PV values bear to the actual PV value at point D. Thus we get

PV per pound	362	$\frac{14.55}{14.60} \times 362 = 360$	$\frac{14.05}{14.60} \times 362 = 348$

Then from Fig. 2, knowing the PV values and the pressures at points 1 and 2, we can read entropies and superheats.

Superheat, deg. F.	93	98.5	92
Entropy (ϕ)	1.190	1.220	1.248

The actual temperature at points 1 and 2 will equal the boiling points at the known pressures plus the superheats, giving

Boiling point, deg. F.	45.5	at 64.5 lb. per sq.in. 33	at 45.9 lb. per sq.in. 18
Actual temperature, deg. F.	45.5 + 93 = 138.5	33 + 98.5 = 131.5	18 + 92 = 110

Thus knowing actual temperatures and entropies, we can plot points 1 and 2 on the diagram.

The line *DF*, like *CC"*, is a constant-pressure line and can be drawn straight. Line *FA* is, of course, a horizontal straight line at constant temperature, which closes the cycle.

A consideration of the chart, as well as our knowledge of the refrigeration process, shows that the ammonia takes up heat through that portion of the cycle represented by *ABCC"D* and gives up heat through the remainder of the cycle. It follows then that the area *ABCC"DFA* represents the difference between heat given up and heat supplied and must therefore be equivalent to the work done by the compressor on *each pound* of ammonia. A planimeter will serve to measure the area of the cycle, which in this case is 17.14 sq.in. Since the co-ordinates are 20 deg. F. of temperature and 0.2 units of entropy per inch, one square inch is equivalent to $20 \times 0.2 = 4.00$ B.t.u. The whole area then represents $17.14 \times 4.00 = 68.56$ B.t.u. per lb. of ammonia.

The total work done by the compressor per hour may be determined by the usual method from the indicator diagram of the ammonia cylinders, adding the powers of the two cylinders and averaging results. For the present cases the total was 6.48 hp. Since one horsepower-hour is equivalent to 2,545 B.t.u., the heat equivalent to the compressor horsepower is $2,545 \times 6.48 =$ 16,500 B.t.u. per hour.

Evidently, then, the B.t.u. work per hour performed by the compressor divided by the work *per pound* of ammonia will give the weight in circulation per hour, that is,

$$\frac{16{,}500\ (\times\ 778)}{68.56\ (\times\ 778)} = 240\ lb.\ per\ hr.$$

This result checks that of the first method within 2 per cent.

It should be pointed out that the temperature-entropy method is very susceptible to error caused by inaccuracy of pressure determination. For instance, if the suction pressure is incorrect by two pounds, the corresponding boiling point will be in error by at least two degrees. This will raise or lower the line *BC* and seriously alter the work area of the diagram, which is the ultimate factor in determining the weight. An error in discharging pressure will have a similar but smaller effect. Thus it will be noted that the *PV* method is not only shorter and simpler, but is probably more accurate than the temperature-entropy method.

According to the Geological Survey's report, the average daily production of electricity by public utility power plants during January was 124,600,000 kw.-hr., during February 119,800,000 kw.-hr., and during March 121,800,000 kw.-hr. Of this 33 per cent in January and February and 38 per cent in March was produced by water power. To help produce this energy 10,247,947 tons of coal, 3,481,742 bbl. of oil and 4,553,228 cu.ft. of gas were consumed.

A Steam Alignment Diagram

The use of an "alignment" diagram for the graphical solution of steam problems is proposed in an article by D. Halton Thomson in a recent issue of *Engineering*, London. The accompanying diagram is reproduced from this article and is used here simply to illustrate the author's ideas. No attempt should be made to use this copy for numerical work, as the repeated reproductions and the small scale have destroyed its value for that purpose.

The six most important properties that appear in steam calculations are pressure, volume, temperature, entropy, quality (superheat or dryness fraction) and total heat. The well-known Mollier diagram, in which total heat and entropy are the co-ordinates, usually has the pressure and quality shown by families of curves known as constant-pressure and constant-quality lines. Theoretically, lines of constant volume and constant temperature might be added to such a diagram, but the resulting complication of lines would render the plot difficult to work with. The result is that either two diagrams or one diagram and a set of tables must be used in the solution of most problems.

It may be shown that if any group of correlated variables can be represented by a diagram consisting wholly of families of straight lines, this diagram may be transformed to the alignment system so that any three (or more) straight lines passing through the same point on the cartesian system correspond to three (or more) points lying on a straight line on the alignment system. The first step, then, is to produce a cartesian diagram consisting wholly of straight lines.

The ordinary steam diagrams in use consist of families of curved lines, but a study of some of Callender's equations suggests that by changing the scale of the co-ordinates these lines might be straightened. A diagram was accordingly plotted using values of *log p* and *log (H-835.2)* as co-ordinates. In this case the entropy and superheated-steam-volume lines were perfectly straight, while the quality, total-heat and wet-steam-volume lines were so nearly straight as to introduce only negligible errors. From these considerations the alignment diagram has been plotted, the scales being laid out in accordance with the modified logarithmic formulas, but the graduations being marked with the direct values of the properties. By the use of the diagram as given, practically all of the ordinary steam problems may be solved directly.

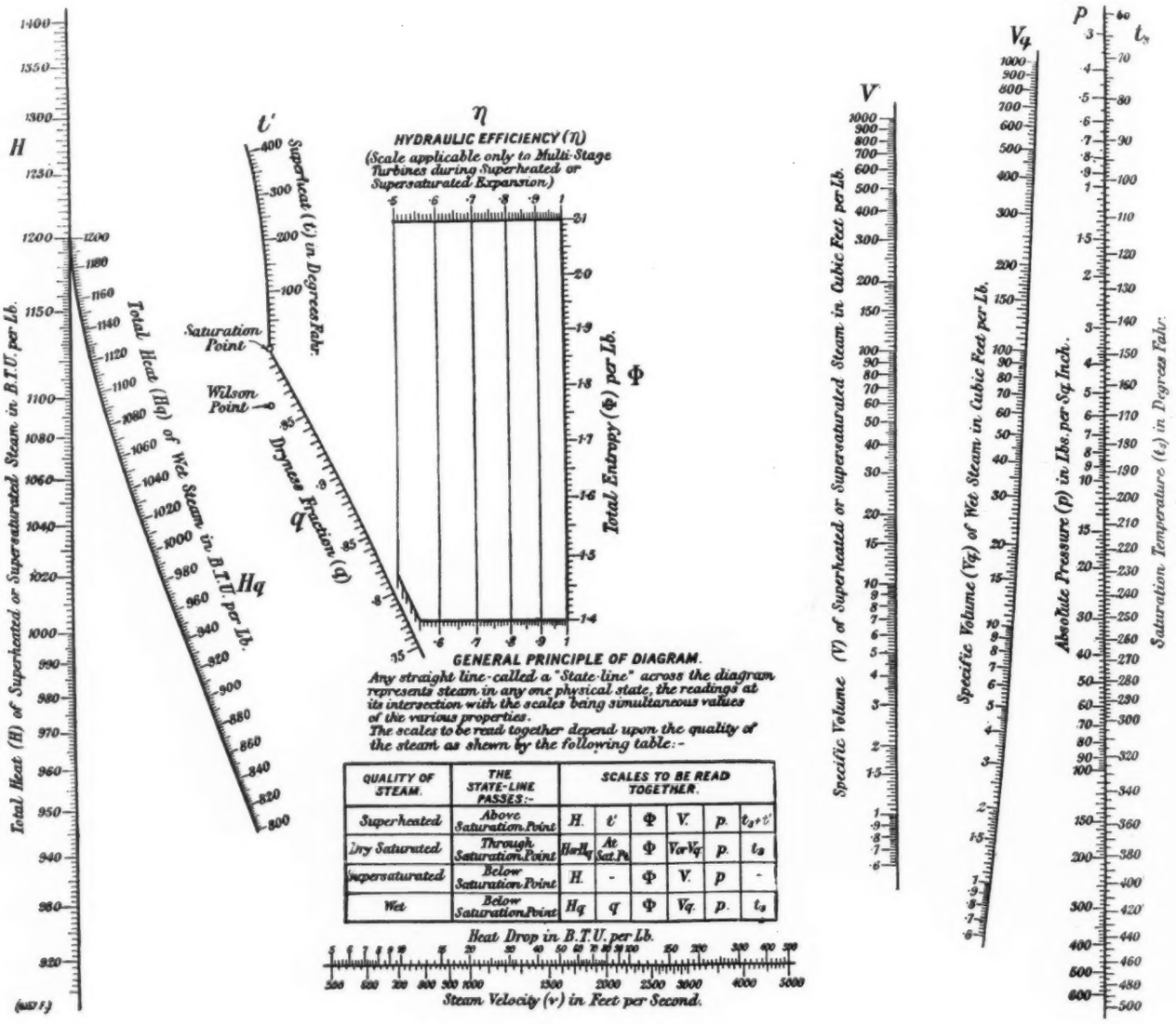
In using an alignment diagram, it must be remembered that any straight line drawn across the diagram represents a certain condition, or "state," which would be represented by a point in a cartesian diagram. Such a line, then, is called a "state line," and its intersection with the different scales gives the state properties, just as the position of the "state point" gives the state properties by its position in relation to the various property lines on a cartesian diagram.

For example, given steam at 160 lb. pressure and superheated 50 deg. F. A straight line from the 160-lb. point on the pressure or p scale through the 50-deg. point on the superheat or t' scale intersects the total heat, or H, scale at 1,229 B.t.u., the entropy, or ϕ, scale at 1,603 and the volume, or V, scale at 3.05 cu.ft.

It must be noted that when the steam is superheated or supersaturated the scales marked H and V must be used, but when dealing with wet steam scales H_q and V_q must be used. The point marked *Wilson Point*

represents the lower limit of complete supersaturation as determined by Wilson's experiments, and if the state line passes below this point the steam is to be considered wet. If the state line passes between the *Wilson Point* and the *Saturation Point*, the steam will be either wet or supersaturated, depending on whether it is or is not in a state of equilibrium. This point must be determined from the conditions of each special problem.

In a problem involving expansion in a nozzle, the process is not isoentropic and corrections must be introduced. Assume the expansion between the conditions assumed in the preceding examples with a friction factor of 0.12. The adiabatic heat drop will be found from the difference of the values already found 1,229 — 953 = 276 B.t.u. The heat transformed into velocity will then be 276 (1 — 0.12), or 243 B.t.u., leaving


Total Heat (H) of Superheated or Superheated Steam in B.T.U. per Lb.
Total Heat (Hq) of Wet Steam in B.T.U. per Lb.
Hq
t'
Superheat (t') in Degrees Fahr.
Saturation Point
Wilson Point
Dryness Fraction (q)
q
η
HYDRAULIC EFFICIENCY (η)
(Scale applicable only to Multi-Stage Turbines during Superheated or Supersaturated Expansion)
Φ
Total Entropy (Φ) per Lb.
GENERAL PRINCIPLE OF DIAGRAM.
Any straight line-called a "State-line" across the diagram represents steam in any one physical state, the readings at its intersection with the scales being simultaneous values of the various properties.
The scales to be read together depend upon the quality of the steam as shewn by the following table:-
Heat Drop in B.T.U. per Lb.
Steam Velocity (v) in Feet per Second.
V
Specific Volume (V) of Superheated or Superheated Steam in Cubic Feet per Lb.
Vq
Specific Volume (Vq) of Wet Steam in Cubic Feet per Lb.
p
Absolute Pressure (p) in Lbs. per Sq. Inch.
ts
Saturation Temperature (ts) in Degrees Fahr.

QUALITY OF STEAM.	THE STATE-LINE PASSES:-	SCALES TO BE READ TOGETHER.					
Superheated	Above Saturation Point	H.	t'	Φ	V.	p.	$t_s + t'$
Dry Saturated	Through Saturation Point	Hor H_q	At Sat. Pt.	Φ	Vor V_q	p.	t_s
Supersaturated	Below Saturation Point	H.	-	Φ	V.	p	-
Wet	Below Saturation Point	H_q	q	Φ	V_q	p.	t_s

AN ALIGNMENT DIAGRAM OF STEAM PROPERTIES

In solving a problem involving a change of state, the final values are obtained from a new state line. Since most problems assume a change with some one property constant, the new state line must intersect the old state line on the scale of the constant property. For example, suppose steam at the conditions assumed is to expand adiabatically to a pressure of 3 lb. absolute. In this case the entropy remains constant, so the new state line will pass through the point 1.603 on the entropy scale and 3 lb. on the pressure scale. Since the final state will obviously be in the wet steam region, the heat content is read on the H_q scale at 953 B.t.u., the volume on the V_q scale at 98 cu.ft., and the quality on the q scale at 0.832.

1,229 — 243, or 986 B.t.u., in the steam. The actual final state line will then pass through 986 on the H_q scale and 3 lb. on the p scale, and the quality 0.865 and the volume 102 cu.ft. may be read on the q and V_q scales respectively.

It must be admitted that values from this diagram, even as originally prepared on a large scale, will be somewhat in error due to the deviation from the straight lines of some of the curves in the cartesian diagram. The author claims, however, that the results will not be greatly in error and that where extreme refinement is desired they may be checked by computation, while for ordinary calculations, especially in preliminary designs, such a chart is sufficiently accurate.

Osborn Monnett—A Leader in Smoke Abatement

Self-Made Engineer Who Built for the Future. An Expert on Combustion Who Has Specialized on the Elimination of Smoke

A MAN who will look forward in his profession for a quarter of a century, attempt to analyze conditions and predict the trend of development with the view of anticipating the progress to be made and to meet it by mapping out a definite course of instruction, is a rare exception. Osborn Monnett may be placed in this class. First of all he had a definite ambition to become a steam power plant operating engineer. He realized that the requirements of a good engineer called for a practical knowledge of boilermaking, steamfitting, general operation and, perhaps of first importance, chemistry. Refinements in combustion and boiler practice depend largely upon chemistry today and upon the use of chemical apparatus unheard of in the power plant twenty years ago, at the beginning of Monnett's career. The problems of the future—for example, low-temperature distillation of coal with recovery of byproducts — call more and more for chemistry, so that Mr. Monnett made an excellent guess when he placed industrial chemistry as one of the chief requirements for an up-to-date engineer of the present and the future. In 1876 Monnett was born in Norfolk, Va., but soon after his parents removed to Ohio, their native state, where he received a grammar-school education. His first practical work as an engineer was in Kentucky, running a sawmill that produced white-oak staves and lumber. It can be truly said that he started at the bottom rung of the ladder, but the sawmill job was only temporary. He knew that the best kind of training could be obtained on the water, where a man was placed upon his own resources and had to be more than a "runner" to get by. Accordingly, he arranged to enter the marine field and for the four years dating from 1899 was employed on the great Lakes in the engine rooms of coal and ore carriers with large triple-expansion engines, Scotch marine boilers and all the usual equipment on these steamers. During this period he progressed from coal passer to fireman, water tender and oiler to first assistant engineer.

With such experience back of him he left the service to become chief engineer of the W. & L. E. Shops at Norwalk, Ohio, and later for four years was in a similar position in the Rock Island Shops at Moline, Ill. It was here that he began studying chemistry, graduating eventually from a correspondence course in qualitative and quantitative analysis. During his studies he set up a laboratory at the plant and specialized in chemical problems relating to his work, such as combustion, feed water, etc. As a postgraduate course in chemistry he worked for a short time in the laboratory of the American Steel and Wire Co., at Cleveland, where practical experience was obtained in general commercial work.

His progressive tendencies had attracted the attention of the editor of *The Engineer*, published at that time in Chicago, and in 1907 he was asked to join the editorial staff. It was new work, but he liked it, and a year later he went with the paper to New York when it was consolidated with *Power*. He soon returned from the East as Western editor in charge of the Chicago office of the Hill Publishing Co. For three years he traveled extensively, keeping in touch with all that was new and interesting in the power-plant field and among other things specialized on boiler explosions. In 1911 the wheel took another turn, and Monnett was appointed chief smoke inspector of Chicago, serving four years under Mayor Harrison. The organization of the smoke department at that time was excellent. It contained a number of mechanical engineers who in their work had accumulated a large amount of information relative to furnace design and the setting of boilers. The data, however, were not available except among the men themselves, so that it was his immediate effort to sift this information and get it down on paper so that it could be used in the general field of engineering. As a result of this work standards for boiler settings were developed, using all known types of furnaces, stokers and boilers. These standards have since been largely copied by Cincinnati, Pittsburgh and other cities.

Following the four-year period in the City Hall he was engaged in research work relating to low-pressure boilers and low rates of combustion with the American Radiator Co. in Chicago and Buffalo. During this time he lectured extensively on smoke-abatement problems before chambers of commerce, civic organizations and various mechanical engineering associations in many of the cities of the Middle West. When the war came on and he heard the call to service,

He became a member of the Conservation Committee of the Fuel Administration for the State of Illinois and helped to prepare educational pamphlets and lectures relating to the saving of fuel. Later, he went to Washington as a member of the Conservation Bureau of the United States Fuel Administration. Among the more important tasks assigned to him was the conservation of fuel in the entire sugar industry of the United States, negotiations being conducted in New York with the managers and principal officers of the sugar-refining companies. This involved important questions of policy and methods in the use and distribution of coal in quantity, complicated by joint action with the Food Administration. He also represented the Conservation Bureau of the Fuel Administration on the Priority Committee of the War Industrial Board.

Since the armistice Monnett has been cashing in on his wide and varied experience. He has become one of the consulting engineers of Chicago specializing in combustion matters and boiler practice. Of the notable work he has done during the past year, mention might be made of the atmospheric survey of Salt Lake City conducted for the Government in the capacity of consulting fuel engineer for the United States Bureau of Mines. This work has extended over a period of eight months from September, 1919, to May, 1920, and has included a careful chemical and physical examination of the atmosphere not only with relation to smoke and smoke abatement, but also to the presence of smelter gases. During this investigation airplanes were used for the first time in taking air samples. A fuel survey and soot-fall study was included, together with a large amount of chemical and microscopical work in examining the filtrates and precipitates obtained.

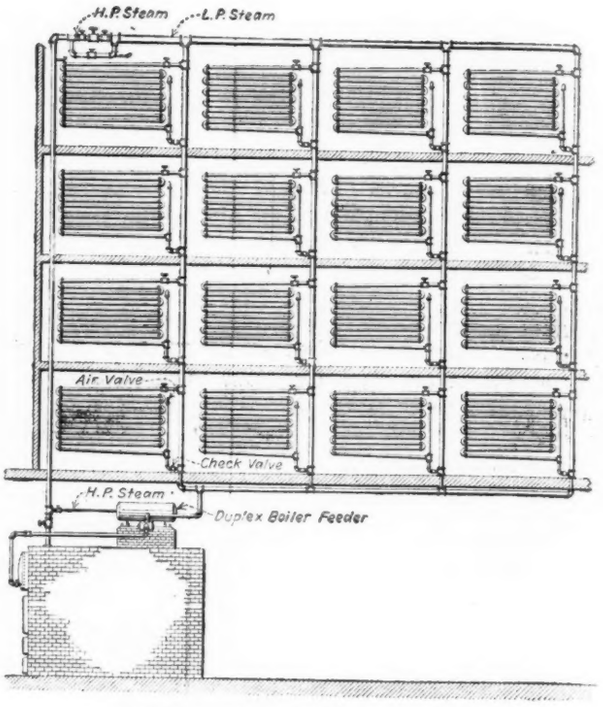
His reputation on questions involving smoke gained him a place on the Chicago Association of Commerce Committee on Atmospheric Pollution, a body formed to study all forms of contamination in the air of the city, together with the best methods of reducing the nuisance to a minimum.

Farnsworth Heating System

Building superintendents and heating engineers will be interested in a piping layout for a heating system that provides a closed-loop circuit, whereby the water of condensation from the radiators is returned directly into the boiler. This system has been developed by the Farnsworth Company, Conshohocken, Pa. With the system is used a duplex boiler feeder, which permits a continuous flow of condensation into the boiler. The condensation is held under pressure and is delivered into the boiler at a temperature only one or two degrees below that of the steam, corresponding to the pressure carried on the heating system. These results are obtained without the use of a receiving tank. There are no vents open to the atmosphere and practically no heat loss.

When the high-pressure steam from the boiler is carried to the top of the building, it passes through a reducing valve and then the risers drop from the main line to supply the various coils. The return line of the coil is carried back into the riser with a drop of nine inches before entering the riser with a check valve. By this static head of nine inches all water between the check valve and the lowest pipe of the coil is sufficient to lift the check valve and let the condensation to the coil flow back into the same steam riser.

A full-sized pipe is carried from the return pipe of the coil to somewhere near the top of the coil, where an automatic air valve is inserted. This pipe provides a sort of air chamber and eliminates the possibility of any water squirting out of the air valve. The return



PIPING OF HEATING SYSTEM

pipe from the risers is carried into a duplex boiler feeder located somewhere above the water line of the boilers.

In this system no return lines are necessary other than to connect the risers to the boiler feeder, which feeds the condensation into the boiler at the same temperature that it leaves the system. In other words, the condensation is held under a pressure and is fed directly into the boiler.

The First Boiler Explosion

Rhys Jenkins, in an article entitled "Links in the History of Engineering," in *The Engineer* (London), quotes from an unpublished manuscript of Farey's an account of what seems to have been the first boiler explosion.

It occurred on Sept. 8, 1803. An engine had been set up temporarily to drain the foundations for a large building in course of erection for a tidal corn mill on the banks of the Thames, between Greenwich and Woolwich. The engine was in charge of a boy who is said to have fixed the safety valve by inserting a prop between it and the roof of the boiler-house.

The boy went away, leaving the engine at work, so that when soon afterward it was stopped by another workman, the steam had no outlet and an explosion took place, causing the death of three persons and serious injuries to three others. This was at about the time that Trevithick was being called a murderer by Watt for his use of high-pressure steam, less than fifty pounds, and is said to have considerably retarded the use of the "high-pressure," or noncondensing engine.

Interconnecting Industrial and Central-Station Plants

BY CORNELIUS G. WEBER

With data from a number of individual cases the author gives some indication of the large savings in coal, labor and transportation that would be possible from electrical interconnection on a give-and-take basis.

IF ALL industrial establishments were to purchase their electric energy from large public utilities, a large amount of coal would be saved as far as the generation of electrical energy is concerned, but the fact that many industries require heat in the form of low-pressure steam at once makes it more profitable for such industries to generate energy as a byproduct. Usually, such an industry will generate only as much energy as it requires for its own use and will operate an engine only as economical in fuel consumption as the case may require. No attention is given to the possibility of generating all the energy economically feasible to generate from the steam used and to dispose of the excess amount, for where would there be a market? No less an authority than Dr. Steinmetz had the following to say on present methods:

We realize that our present method of using our coal resources is terribly inefficient. We know that in the conversion of the chemical energy of coal into mechanical or electrical energy, we have to pass through heat energy and thereby submit to the excessively low efficiency or transformation from low-grade heat energy to the high-grade electrical energy. We get at best 10 to 20 per cent of the chemical energy of the coal as electrical energy; the remaining 80 to 90 per cent we throw away as heat in the condensing water or, worse still, have to pay for getting rid of it. At the same time we burn many millions of tons of coal to produce heat energy and, by degrading the chemical energy into heat, waste the potential high-grade energy which those millions of tons of coal could supply us. It is an economic crime to burn coal for mere heating without first taking out as much high-grade energy, mechanical or electrical, as is economically feasible. It is this feature of using the available high-grade energy of the coal, before using it for heating, which makes the isolated station successful though it has every other feature against it.

As time goes on, we will come to recognize more and more that it is economically criminal to burn coal for mere heating purposes or for electrical energy only, and a day will dawn when fuel will have attained such a high price that all will recognize the full truth and take steps to utilize fuel as economically as possible. One such means no doubt will be the generation of electrical energy as a byproduct to the fullest measure in all manufacturing establishments wherein steam heating processes are involved.

Since it is highly probable that the time is not so very remote when all power plants, large and small, will be electrically interconnected and operating on a give-and-take basis, it might be of interest at this time to face conditions as they obtain in several specific cases and aim to draw such conclusions as a few cases will allow. In the practice of his profession the writer has not only visited and inspected many industrial plants, but in the instances considered hereinafter has made exhaustive tests and analyses including the measurements of live- and exhaust-steam consumption of apparatus and processes, boiler tests, economic performance tests, heating-load tests, etc., all for the purpose of working out in each individual case a plan of rehabilitation that would reduce the fuel consumption of the specific establishment investigated. All such investigations resulted in the compilations of detailed reports based on facts and measurements, and since plants of widely varying character were encountered, it occurred that it might be of interest to work out the over-all fuel economy that could be anticipated in the cases considered in the event that they were electrically interconnected and were generating electrical energy only in proportion to the fuel needed for heating and processes, disposing of excess energy to the central station at times when more energy than needed was being generated and purchasing energy from the central station when a deficiency occurred.

In addition to the fuel economies possible in the plants considered as independent units, the probable additional fuel savings that would result, were these plants provided with induction or other generators and connected to the public-service company's distribution system, have also been worked out. The plants considered embrace industries of the following kinds: Automobile parts, machine manufacturing, food products, sheet-metal products, leather manufacturing, woodworking, structural-steel fabricating, textile goods and dyeworks.

In each instance the fuel consumption was first determined and from boiler and engine tests the economic performance was determined. The low-pressure steam requirements for heating and process work were then found after which the annual fuel consumption was computed on the basis of proper performance of the boilers, the installation of more economical prime movers and the utilization to best advantage of the exhaust steam.

In this discussion the conclusions reached are based on careful analyses and practically all of the cases considered were worked out in the same detail as one typical case which follows:

The graph shown in Fig. 1 represents the operating conditions as found by test. It is self-explanatory in so far as it represents steam utilization. There is this to be added, however—the fuel consumption under the conditions revealed was 6,033 tons per annum. The processes utilized live steam at low pressure, the boilers were operating at an efficiency of only 63.2 per cent and the Corliss engine was consuming on an average 43 lb. of steam per indicated-horsepower per hour.

Annual energy requirements of the plant are about 610,000 kw.-hr. under the conditions shown in Fig. 3, wherein electrification is contemplated. Fig. 2 shows the operation of the same plant under the conditions wherein the live steam for processes is replaced by exhaust steam, the boilers brought up to proper efficiency, waste heat reclaimed from a solution cooler and

the Corliss engine carefully repaired to bring its steam consumption down to about 30 lb. of steam per indicated-horsepower per hour. The annual fuel consumption represented by Fig. 2 is 3,519 tons.

Fig. 3 represents the operation of the same plant contemplating the installation of a direct-connected, poppet-valve, engine-driven generating unit, the use of superheated steam and the elimination of a considerable friction load by electrification. The annual fuel consumption under conditions as shown in Fig. 3, is 3,100 tons.

It will be noticed that under the conditions shown in both Figs. 2 and 3, there is not enough exhaust steam during the colder months to meet the requirements and that a considerable amount of live steam for building heating and process work is necessary. This steam, being all low-pressure steam, could first be drawn through a larger engine and additional electric energy latter figure only the additional fixed charges on the larger engine and generator would have to be figured.

As it happens, the plant discussed is not a consumer of central-station energy, but it seems reasonable that under present conditions even a central station could afford to purchase energy at one cent per kilowatt-hour. In this special case the industrial-plant owner would be ahead $3,050 per year, less the fixed charges on that portion alone of the prime-mover equipment cost which is larger than his own needs require. The central station would be ahead by the profit represented by $1,250 worth of new business, it being assumed that the fuel and labor charges in the central station amount to 1c. per kw.-hr. Should it cost the central station more than one cent for these items of coal and labor, then the central station would make an additional profit. It is apparent, of course, that the industrial-plant

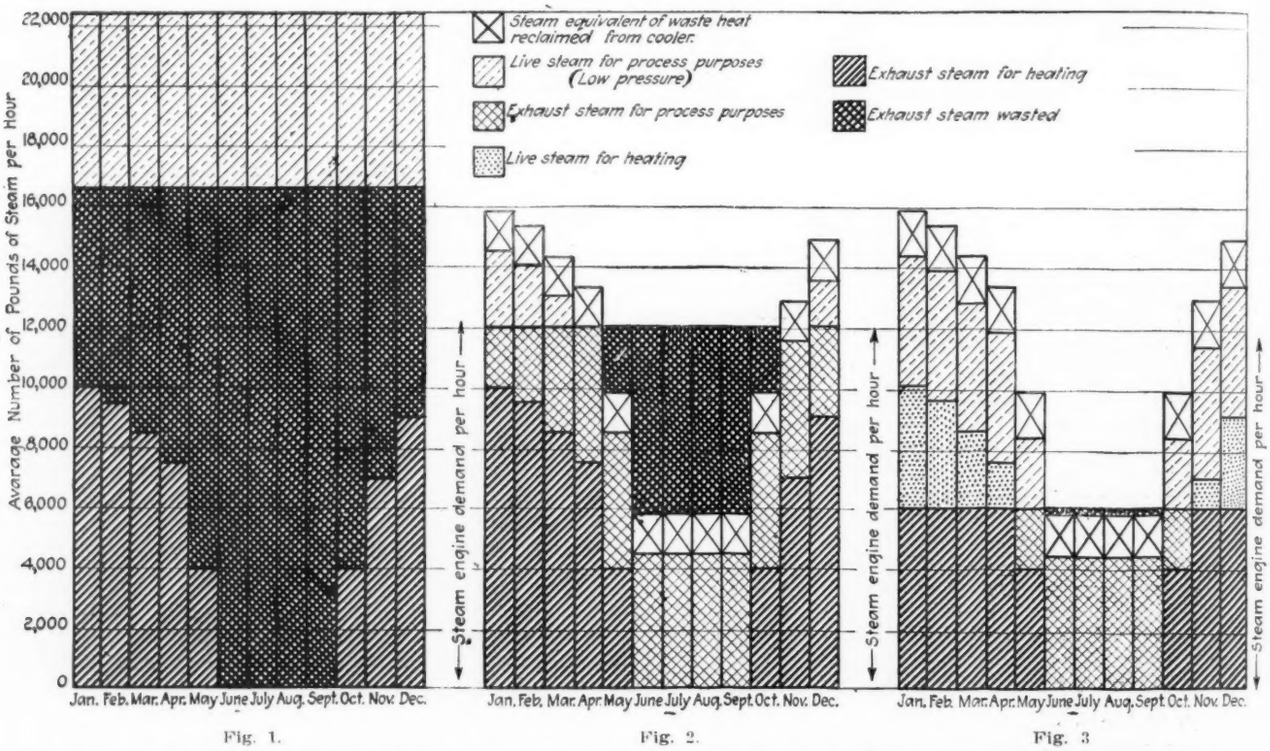


Fig. 1. Fig. 2. Fig. 3

FIGS. 1 TO 3. STEAM REQUIREMENTS OF A TYPICAL INDUSTRIAL PLANT UNDER DIFFERENT CONDITIONS

Fig. 1—Steam per hour for various months in a typical industrial power plant. Fig. 2—Operation of same plant as in Fig. 1, live steam replaced by exhaust steam. Fig. 3—Operation of same plant, but with poppet-valve engine driven generating unit, superheated steam and electric drive.

generated to be fed into the public-utility company's distributing system.

The amount of additional energy that could be so generated under conditions shown in Fig. 3, would be 360,000 kw.-hr. per annum. During the months of June, July, August and September, when some exhaust steam would be going to waste, this plant could utilize about 50,000 kw.-hr., of central-station energy to keep from wasting exhaust steam. This procedure would eliminate about 100 tons of coal, which, if valued at $700, would mean that to break even financially the plant in question could not afford to pay more than 1.4c. per kw.-hr. However, if the central station were purchasing the 360,000 kw.-hr. at, say, 1c. and were charging for the 50,000 kw.-hr., 2.5c., the plant under consideration would still be ahead by an amount of ($3,600 + $700) — $1,250 = $3,050, against which owner could generate the 50,000 kw.-hr. during the summer months at less than 2.5c. per kw.-hr. and that, financially, it would be to his advantage not to purchase such energy. This is true; but it must be borne in mind that he would no doubt agree to pay the amount of $1,250, of which only $550 actually represents added cost, for the privilege and opportunity to dispose of the excess energy that he would be generating as a byproduct. It is evident that the foregoing represents a profit to both parties concerned.

With such a co-operative arrangement the amount of fuel conserved for the nation at large would be about as follows: Assuming that the central station can generate energy at as low a rate as 2.5 lb. of coal per kilowatt-hour, then the purchase of the 360,000 kw.-hr., cited previously, would conserve 450 tons of fuel, since the central station would be buying 360,000 kw.-hr.

for the generation of which it would otherwise have to burn 450 tons of coal.

During the summer months when the public-service company would be selling 50,000 kw.-hr. of energy to the industrial plant, the central station would consume 63.5 tons of coal, where the industrial plant would be consuming about 100 tons, thereby bringing about an additional saving of 37.5 tons, or a grand total of 487.5 tons.

In round numbers the annual fuel saving in so far as the nation is concerned would be from 475 to 500 tons. At $7 per ton, this would represent about $3,500 per year, which latter figure must be reconciled with the industrial-plant owner's $3,050 profit and the central station's profit on $1,250 worth of new business.

The summary of the foregoing is shown as plant No. 5, in Fig. 4. By consulting the key, the graph becomes self-explanatory. Representations above the line 0-0 show the industrial power-plant operation and those below the line, the public utility's operation in so far as it is or would be affected by the industrial power plant in relation to which it is considered. In

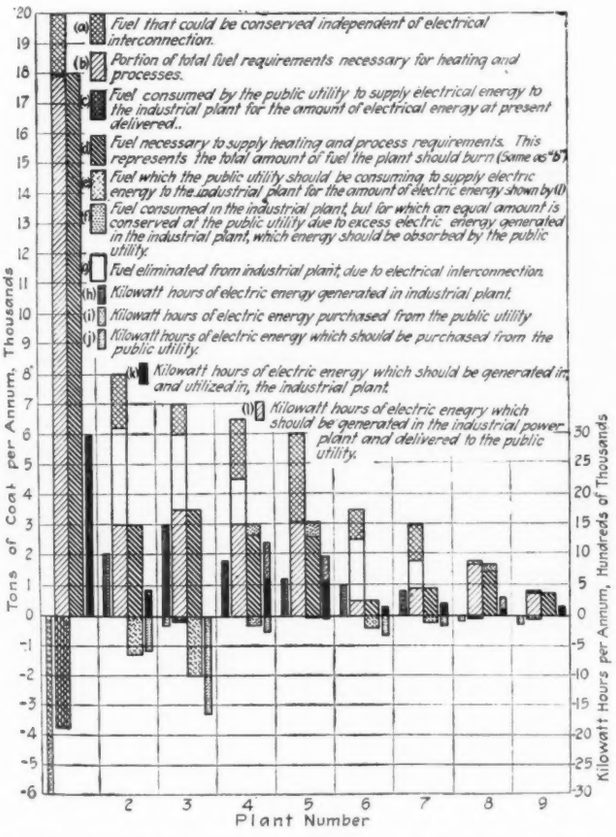

(a) Fuel that could be conserved independent of electrical interconnection.
(b) Portion of total fuel requirements necessary for heating and processes.
(c) Fuel consumed by the public utility to supply electrical energy to the industrial plant for the amount of electrical energy at present delivered..
(d) Fuel necessary to supply heating and process requirements. This represents the total amount of fuel the plant should burn (Same as "b")
(e) Fuel which the public utility should be consuming to supply electric energy to the industrial plant for the amount of electric energy shown by (i)
(f) Fuel consumed in the industrial plant, but for which an equal amount is conserved at the public utility due to excess electric energy generated in the industrial plant, which energy should be absorbed by the public utility.
(g) Fuel eliminated from industrial plant, due to electrical interconnection.
(h) Kilowatt hours of electric energy generated in industrial plant.
(i) Kilowatt hours of electric energy purchased from the public utility
(j) Kilowatt hours of electric energy which should be purchased from the public utility.
(k) Kilowatt hours of electric energy which should be generated in, and utilized in, the industrial plant.
(l) Kilowatt hours of electric energy which should be generated in the industrial power plant and delivered to the public utility.
Tons of Coal per Annum, Thousands
Kilowatt Hours per Annum, Hundreds of Thousands
Plant Number

FIG. 4. SUMMARY CHART COVERING SEVERAL TYPICAL INDUSTRIAL POWER PLANTS

The purpose of the chart is to show the effect of co-operation between these plants and the central station. The cases are, of course, hypothetical.

Fig. 4 there are four sets of bends to each plant representation. The two to the left show actual conditions as found and the two to the right as they would obtain under electrical interconnection conditions.

By a similar process of analysis several other typical industrial power plants have been charted in a summary way, as further shown in Fig. 4. For convenience they have been arranged according to magnitude of coal consumption. Data on numerous other plants are in possession of the writer, and only typical cases have been selected.

There is this to be said specially about plant No. 1: The plant operates gas engines for generating electric energy, but burns 20,000 tons of coal exclusive of the gas engines for high- and low-pressure steam pur-

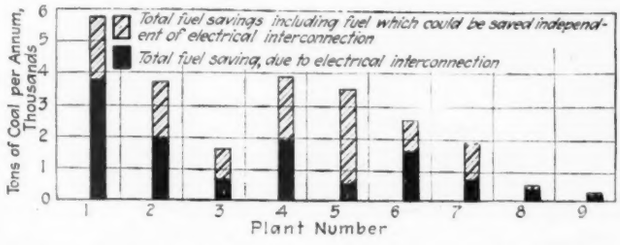

Total fuel savings including fuel which could be saved independent of electrical interconnection
Total fuel saving, due to electrical interconnection
Tons of Coal per Annum, Thousands
Plant Number

FIG. 5. A SUMMARY OF FIG. 4, SHOWING TOTAL QUANTITIES OF FUEL SAVED UNDER ASSUMED CONDITIONS

poses, at the same time purchasing 3,000,000 kw.-hr. of electric energy. Only fuel burned for steam purposes has been considered and that portion of the steam which is used at low pressure if first taken through an engine as a reducing valve would be just sufficient to generate the same amount of energy as is now purchased. As it happens the power demand is practically uniform, and since low-pressure steam is used also at almost a uniform rate, this steam would generate energy in proportion to the amounts needed.

Fig. 5 is a summary of Fig. 4, showing total quantities of fuel to be saved. As found, the aggregate amount of fuel consumed per annum by the nine plants considered is 56,633 tons. As isolated independent plants under reasonable rehabilitation plans, these same plants would consume only 44,550 tons of fuel, or 12,083 tons less. Electrical interconnection and operation on a give-and-take basis would result in an additional saving of 11,400 tons of coal. The total saving due to rehabilitation and electrical interconnection would be 23,550 tons, as represented by the total areas of the bands shown in Fig. 5. This is 41.5 per cent of 56,633, or in other words a saving of 41.5 per cent in fuel would be possible in these cases. The solid black portions of the bands shown in Fig. 5 represent 11,400 tons. Electrical interconnection would result in a saving of 11,400 tons in 44,500 tons, or 25.5 per cent.

In these cases the public utility would lose 3,425,000 kw.-hr. of business, gain 3,125,000 kw.-hr. and in addition would have to absorb about 1,200,000 kw.-hr., bringing about a net loss of about 1,500,000 kw.-hr. to the public utilities. However, the loss of business would be represented by a large consumer paying a low rate, whereas the new business would be represented by numerous small customers paying a higher rate, and since the 1,200,000 kw.-hr. to be absorbed would be purchased at a low rate, it is probable that the public utility would be benefited. In any event a plan on the order outlined, where plant No. 5 was discussed in detail, would have to be worked out since the co-operative plan would have to be of benefit to the public utility to be attractive and workable.

From a national fuel-conservation standpoint the public utility should be interested in all industrial plants and every industrial plant should be a subscriber to the public utility, which should be operating in a bigger broader and better field.

The writer has come in contact with numerous other cases scattered about the country. In one instance a plant consuming 45,000 tons of coal a year was burning 3,000 tons for heating buildings with live steam. This 3,000 tons could readily have been utilized for power purposes.

As another example, in a town of 3,500 population the local public utility is being operated with uneconomical engines which exhaust the steam to atmosphere. The public utility's plant is located on a large river, and the installation of a condenser would result in saving 20 per cent of the fuel. In this same municipality is a large woodworking establishment consuming a combined amount of coal or its equivalent in wood refuse equal to 9,000 tons of coal per year. The plant operates 24 hours per day, and its exhaust-steam requirements are such that practically 9,000 tons of coal or equivalent would have to be burned for steam-heating purposes regardless of any power requirements. However, this plant was actually considering the purchase of electric energy from a water-power concern, and had this been advised and done, an additional loss to the general public would have been added to an already aggravated situation.

If equipped with high-efficiency engines, the woodworking establishment would have been in position to generate more than all of the electrical energy required by the municipality at night and could have generated more than enough to meet the daytime demands as well as its own needs. In other words, instead of this establishment purchasing energy, it should take advantage of its position to sell energy to the local public utility, allowing the latter to shut down and conserve 2,000 tons of coal per year. If a transmission line should become available, the plant under consideration would be able to retail electric energy to other consumers.

Interconnection a Boon to Industrial Plants

The nation is full of just such possibilities. What we are suffering in national fuel losses, not mentioning labor, transportation and rolling-stock costs, can be imagined when we see what happens in a few specific cases. It is hardly within the scope of this article to dwell further on the details surrounding the actual operation of a combination of plants electrically interconnected. Suffice it to say, that from an engineering standpoint it would be simple and practicable and would be a boon to the industrial plants themselves rather than a hardship. The nine plants mentioned previously do not represent the unusual, but are fair examples of the average. What is happening in them is true in a general way in nearly all medium-sized industrial establishments.

Our annual bituminous-coal production is about 600 million tons. About 90 millions are used for house and building heating, 135 millions for railroad operation, and about 375 millions for industrial purposes, including gas utilities, ore smelters and electric central stations. It seems reasonable to suppose that at least 200 million tons are used per annum by industrial power plants. If only 25 per cent instead of the 41.5 per cent, as found in one typical case, would be saved by electrical interconnection and other means, it would mean an annual saving of 50 million tons, or 1,000,000 fifty-ton cars. Such a train of cars on an air line would stretch three times from New York to San Francisco.

Naval Horsepower of 9,000,000 To Use Oil

More than 8,000,000 bbl. of fuel oil and nearly 3,000,000 gal. of lubricating oil will be required by the Navy during the next fiscal year. These figures have been given out by Admiral R. S. Griffin, chief of the Bureau of Steam Engineering. In addition, Admiral Griffin said:

The demand for oil by the Navy alone looks formidable in comparison with the requirements of two or three years ago, and when it is considered that a large number of merchant ships, completed during the last three years, also burn oil, and that many industrial establishments recently have converted their power equipment to oil burning, the question of an adequate supply of fuel oil for the Navy becomes one of great concern.

I share the views of many regarding the national importance of conserving oil. Without an assured supply, our Navy would be practically useless. I shudder to think what the result would be if anything should occur that even remotely would threaten this supply.

We now have in commission seven battleships of a combined horsepower of 204,000, which burn oil only. In addition to these we have building twelve other battleships of 533,000 hp.; six battle cruisers of 1,080,000 hp., and ten scout cruisers of 900,000 hp., making a total under construction of these three classes of ships aggregating 2,513,000 hp.

In oil-burning destroyers, we have actually completed 234 with an aggregate horsepower of 5,626,000, and have under construction 87 others which will be completed during the next fiscal year and will bring the total horsepower of destroyers up to 7,975,000.

Our submarines already completed aggregate about 80,000 hp. in Diesel engines, and those under construction will more than double this figure.

Besides these vessels of a purely military character, we have others such as mine sweepers, tugs, destroyer and submarine tenders, and fuel ships, in which oil is used as fuel, whose horsepower aggregates 173,400.

To sum up, we actually have completed and ready for service vessels aggregating more than 6,000,000 hp. in which oil alone is used for fuel, and have under construction other vessels which will bring this total up to nearly 9,000,000 hp.

One of the most important considerations for the successful operation of geared marine turbines is the proper lining upon the foundations. At the Hog Island shipyard, the sole plates of foundations for gears and turbines are machined parallel to the line of shafting after the shafting has been lined up. This is done with a special milling machine so set that the sole plate has a taper of 0.020 in. from outboard toward center to facilitate setting the chocks. After the gear case is lowered into place and held by jackscrews measurements are made for the 56 chocks. These chocks are machined from mild steel and are made 0.005 in. thicker than the measurements call for so they may be scraped to fit. The holding-down bolts are given a driving fit by reaming the bolt holes 0.002 in. less diameter than the bolts. A set of these gears for the A type ships weighs 90,000 lb. and has twelve journals. The journals have a clearance of 0.001 in. per in. of diameter.

The tendency these days is toward comparatively small installed ice-making capacity and large ice-storage capacity. This enables holding a good crew the year around, insures large stock at times of great demand and cares for breakdown repair periods. In designing storage houses 50 cu.ft. is usually allowed per ton of ice.

When a fluid is steadily flowing through a pipe, that fluid in contact with the wall of the pipe is practically at rest, the velocity increasing as the axis of the pipe is approached, being maximum at the axis.

EDITORIALS

Will We Have To Come To the Big Stick Again?

FOLLOWING the sad experience of last winter's coal famine, many conferences were held to consider means whereby a repetition of the situation might be avoided. Foremost among the recommendations of these meetings was summer storage.

Summer is here, and what is the situation? Already the daily press is predicting dire results for next winter.

Are the large users of steam coals in the East storing up a supply for the season when the demand is greatest and the transportation facilities least adequate?

No, they are not; and through no fault of their own.

Most of the large consumers are perfectly willing to make the necessary investment in storage facilities and outlay in coal as an insurance against shutdown next winter, but they cannot get the coal.

Instead of building up a reserve supply at this time, they are forced to proceed from hand to mouth.

The condition appears to be due to several factors, chief among which are inadequate production, lack of transportation and terminal facilities, labor troubles at terminals, a large export in coal, and speculative selling.

It is, perhaps, the inability of the railroads to expedite the handling of cars and their tie-up at terminals because of labor troubles or inadequate terminal facilities, that is responsible to a greater extent than mere lack of cars. For last October, just preceding the strike, with practically the same number of cars available as at present, it will be recalled that the transportation of coal beat even the war record of the previous year.

Production at the mines naturally follows ability of the railroads to move the coal, provided there is a brisk demand, and this accounts for the decreased production in certain cases, although the production curve this year has been above that of last year. However, it must be remembered that in the spring of 1919 some industries were running on their war surplus and the demand for several months fell off.

Much has been said of late concerning the increasing export of coal and its effect upon certain sections of the country, notably New England, which receives much of its coal by water, and the Interstate Commerce Commission has already issued priority orders with a view to relieving the New England situation.

As an aftermath of the war Europe is extremely short of coal and is naturally turning to the American market for relief. She needs the coal so badly that she is willing to pay almost any price for it. This being the case, purchasers at home are forced into competitive bidding with foreign buyers. During recent months the foreign shipments have increased to about five times those of pre-war years and the shipments to New England have decreased by twenty-five to forty per cent.

It is argued by the coal interests that this is a perfectly legitimate situation; that the home consumers are welcome to the coal if they will meet the foreigners' price and that there is no more reason for putting an embargo on coal than there is for putting one on cotton or wheat. Besides, Europe needs our coal just as much as it does our wheat.

The argument seems plausible except perhaps to the man who is forced to pay for the coal.

Be that as it may, an embargo, while providing temporary relief to New England and making possible diversion of cars to other sections, is by no means a remedy for existing conditions. If our total exports were stopped, we would still be running over five million tons behind our monthly requirements.

The shortage has created a condition favorable to manipulation and a speculative market, which in turn has probably resulted in further holding of shipments at terminals and yards. Coal prices are on the rampage, and what is bid one day by the man in dire necessity becomes the opening price the following day.

The necessity for a revival of the Fuel Administration will be regretted, and most of all by the coal men themselves. The country is tired of commissions of inquiry and adjustment, which have in practically every instance failed to achieve results. What it needs and is sure to demand is a wielding of the big stick, laws with teeth in them, and an enforcing agency that will see to it that the producer and middle man are allowed fair profits only and that the public is protected from unwarranted profiteering and speculation.

Electrical Interconnection

THINGS that are visionary and idealistic today are realities tomorrow. The bigger and broader ideas in civil and economic life are born of evolution rather than revolution. Rome was not built in a day; neither could the broad idea of electrical interconnection suggested by Mr. Weber on other pages of this issue be carried out in so brief a lapse of time. Civic communities have adopted city planning, whereby a certain goal to be attained ultimately is always kept in mind and the common weal is carefully considered.

In the case of building new industrial power plants or rehabilitating old ones no consideration is given to any feature outside of the sphere of the individual plant, since the byproduct, electrical energy, has no market.

Engineers are fully aware of the situation, but there is no legislation to cope with this haphazard and wasteful procedure. Water power, which at best will never be adequate for industrial demands, will never run out, but the fuel supply will.

It would seem as though the time had arrived for crossing the indistinct dividing line between the idealistic and the realistic, and that within the course of the next decade we should consider electrical interconnection of generating stations, not as an original and modern method of doing things, but as a necessity. With the aid of the leaders in the engineering world, bills

should be enacted into constructive and wholesome laws that would conserve the coal supply.

In the new German legislature a bill was recently introduced providing for government ownership of all industrial and other power plants. Their motive is obvious, for through national economy they hope to recuperate. Similar legislation in this country might not be received with favor, but there is a growing tolerance for the thought that public policy demands the supervision of power plants as well for efficiency as for safety.

As a further possible general plan it might be feasible to encourage an isolated plant to connect with the public-utility service lines when such isolated plant can prove that it can generate electrical energy as a byproduct. This would at once open up an attractive commercial field as auxiliary to the main industry, but if manufacturers could see a handsome profit, they would undoubtedly do much of their own volition in this direction and the solution of the problem would become more or less automatic.

When we think of the vast tonnage of coal that could be conserved, the coal that our railroads must consume for transporting only the wastage, the additional toiling hands in mines, factories and shops that could be utilized for other purposes, not mentioning the still further possibilities, should a constructive movement gain foothold, of operating central stations at coal mines, electrifying railroads, etc., is it not time to look into the remote future, view the whole matter in an open-minded, unprejudiced mood and act, and thereby lay the cornerstone for a greater and broader industrial structure?

Electrically Driven Reversing Steel Mills

ELECTRIC drives have gradually proved their superior merits until they have become an important factor in almost every manufacturing plant and have practically revolutionized many manufacturing processes. They are used on the smallest and on the largest drives, from the dental tool to the largest hoists and steel-mill applications. And in almost every case they are doing the work better, more efficiently and economically than it could be done with mechanical, hydraulic or steam drives. One of the industries in which the introduction of the electric motor has been most seriously contended by the steam engine is in the steel mill. However, the last ten years has witnessed a general adoption of electric motors to all classes of drives in the steel industry; and as for the non-reversing mill, it has been established that, owing to its greater flexibility and reliability, the electric-motor drive is superior to the steam engine in every respect. The electric drive in the continuous-running mill will produce equal tonnage at lower cost, power consumption and maintenance charges than the steam engine—so much so that electric motors are being installed on a very large percentage of main-roll drives in all new installations.

Two of the important factors in the economical operations of electric drives in steel mills are the ease and accuracy with which the power consumption can be measured, and the fact that the equipment must be kept well insulated or it cannot be operated. At best, with the steam engine, it is inconvenient to get an accurate record of power consumption. Whether or not the steam lines are kept well insulated and the joints tight, the old engine will answer to the throttle. The engine will continue to operate even if the valves and piston rings do leak and the vacuum is not maintained at its maximum. Although this may indicate that the engine is a serviceable and reliable piece of machinery, nevertheless operating under such conditions is not conducive to economy, low power costs and maintaining equipment in a high state of repair. These features not infrequently cause the steam engine to show unnecessarily high steam consumption. With the electric motor any serious leaks soon develop into a short-circuit and must be repaired before operation can be continued.

It is in reversing-mill applications that the ability of the electric motor is most seriously contended by the steam engine. Although with electric drive the cost of power per ton of steel rolled is lower than with the steam engine, probably with two or three exceptions the reversing steam engine is rolling a higher tonnage than the reversing electric motor, and tonnage is what the average steel-mill man is chiefly interested in. However, two new reversing mills that have been in operation for some months, according to reports, are equaling if not surpassing the tonnage records of any reversing steam-engine driven mill. The leading article in this issue "Electrically Driven Reversing Steel Mills," by Frazer Jeffrey, is a very interesting discussion on this subject, in that it considers a number of the problems involved in applying a reversing electric drive and then shows how one of the applications was solved. The electric drive in such installations has the handicap of considerable higher first cost, but as the author points out, higher first cost means little if in a reasonable length of time the saving in cost of operation and of maintenance will more than offset it to the extent of showing appreciable gains.

The Water Power Bill Becomes a Law

WHEN Congress adjourned without the President having affixed his signature to the water power bill, it was taken for granted that the measure had been lost and there was keen disappointment among those who had supported repeated attempts at satisfactory legislation during the last eight or ten years. Therefore, recent announcement from the White House that the President, acting upon an opinion of the Attorney General that adjournment of Congress did not deprive him of the ten days allowed by the Constitution for the consideration of a measure, had finally signed the bill, was greeted with general satisfaction.

The bill is necessarily a compromise, and while some of its provisions may not entirely satisfy the extremists on either side, it is generally conceded to be a satisfactory measure and one that will form a basis for constructive development of our water powers.

The West will be particularly gratified at the President's action in view of the need for a wide and comprehensive hydro-electric program to meet the ever-increasing demand for electricity among the Pacific Coast states. In an effort to meet the present power shortage, much new construction is already under way in California, but this consists principally of additions to existing developments. There is still available on public lands a large amount of potential power which has heretofore remained undeveloped because of the unsatisfactory method of granting permits.

CORRESPONDENCE

Case of a Stuck Governor Valve

The following experience with an engine that failed to start after being shut down for several months may be of interest. The engine in question was in a small sawmill and was of the horizontal slide-valve type, provided with a throttling governor. The mill had been shut down for nearly a year, and when it was desired to reopen it the engineer, who had been employed to operate the power plant, was unable to start the engine. He telephoned for a friend of mine, who, although he is not a regular engineer, had been successful in locating trouble in a number of small plants.

On arriving at the mill, he found steam up and everything about the boiler and engine apparently in good order. The engineer had already closed the stop valve in the main steam pipe next to the boiler and had removed the bonnet from the throttle valve and also the steam-chest cover. There was nothing wrong at these points, and yet, upon opening the boiler-stop valve and the throttle, no steam appeared in the open steam chest.

My friend naturally thought of the governor and asked if this had been examined. The engineer replied that it had not been taken apart as it worked all right. On raising the balls they did appear to move easily—rather too easily, my friend thought. The engineer said that when he had first come to the mill that morning he had raised the governor balls and that they seemed to be stuck, but had come loose in a short time.

That was the whole trouble. The governor was taken apart, and it was found that the valve had corroded tightly to its seat. The valve stem at its lower point was also somewhat corroded and when the engineer had pried up on the balls, the stem had broken off short. Nearly a day's delay had resulted through this simple sticking of a valve. Moral: Sometimes the "insides" of a device may be "out of gear," even if the exterior appearance and its apparent working are correct.

Washington, D. C. HUGH G. BOUTELL.

Traveling Screens Reduced Labor

The accompanying illustrations show a cooling system now in use at the plant of the Connecticut Light and Power Co., Waterbury, Conn. A set of traveling water screens are housed in the small shed shown immediately above the intake in Fig. 1.

This plant is on the Naugatuck River, and at a point just below where the picture was taken, there is a dam over which the water frequently does not flow during the summer months. This practically makes a cesspool of the pond formed opposite the power house, and before the traveling screens were installed, two or three men were required, sometimes twenty-four hours a day, to clean the racks in order to permit sufficient condensing water to enter the intake. The traveling screen has eliminated all this labor and has also reduced the condenser cleanings by about 50 per cent.

From the condensers the cooling water is discharged through the spray pipes, as shown, into the river. A flume built parallel to the bank, Fig. 2, prevents this water from immediately returning to the intake. This flume is two or three blocks in length so that the water must travel a considerable distance, giving it additional opportunity to cool before again entering the intake.

Milwaukee, Wis. W. H. BRANDT.

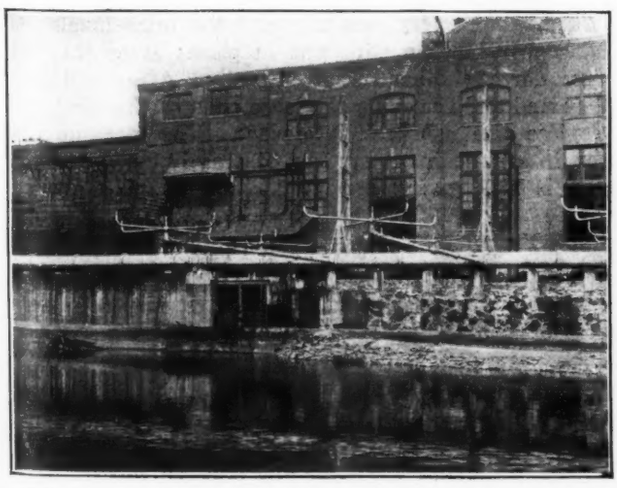


FIG. 1. SPRAY NOZZLES AND INTAKE TO SCREENS

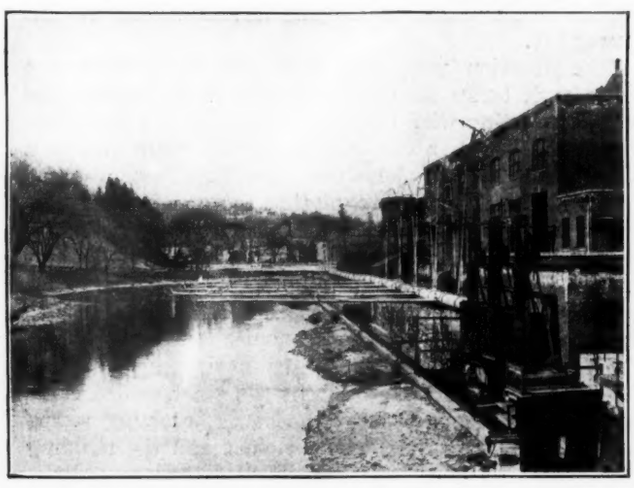
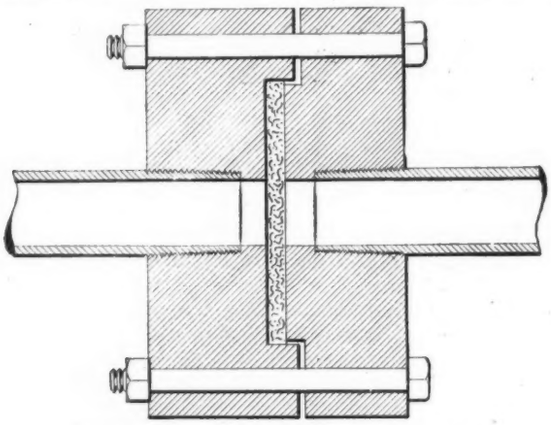


FIG. 2. VIEW OF POND AND DISCHARGE FLUME

An Emergency Union

Extra-heavy fittings for extremely high pressures are sometimes hard to get, and unless they are carried in stock a break in a line of this kind is likely to cause a lot of worry, as well as some delay in the operation of the machinery depending on the line. I had such an experience, when a union on a 1¼-in. hydraulic line,



CROSS-SECTION THROUGH THE UNION

carrying 3,500 lb. pressure, broke. Extra fittings had been ordered, but were not then in stock, so a new one of some sort had to be devised.

A piece of scrap shafting about 4 in. in diameter was secured and two pieces were sawed off about 1¼ in. thick. These were placed in a lathe, faced off, bored and threaded to fit the pipe. They were then chucked with the other side out, faced and one made female and the other male, as shown in the sketch. Four half-inch bolt holes were then drilled in each half of the union to match. A sole-leather gasket was made to fit into the cavity in the female half, and the job was finished.

When installed, this union held and it is still holding this high pressure, and there has never been any appreciable leakage. P. A. GETT.

Cherryvale, Kan.

Used Natural Refrigeration

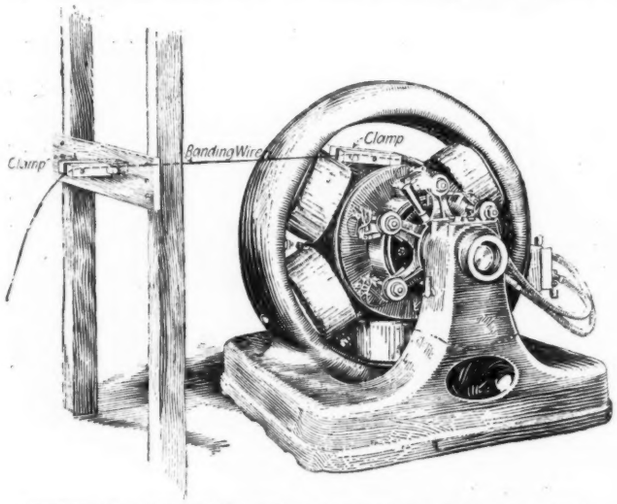
In a certain plant a motor-driven ice machine was run all the year round to cool refrigerator boxes in various parts of the building. Purchased current was used at considerable expense and after a time it dawned upon us that if these boxes had openings to the outside in winterthe result would be a considerable saving in the power bill.

The situation was gone over and ducts were run from such boxes as were near the wall, through the wall, connecting with tight insulated doors in the boxes. From the boxes in the basement ducts were run to a point about ten feet above the sidewalk. These also had doors in them, and by regulating the opening of these doors fairly good temperature regulation was maintained throughout the cold weather with a notable saving in the power bill. It might be added that these openings were screened to keep out birds, insects, etc., and each had overhanging canopies to protect them from the weather. Besides the saving in power, a chance was afforded to overhaul the plant, which could not be done before without the boxes becoming warm, as they were constantly being opened and the building was heated. G. F. KLUGMANN, JR.

St. Louis, Mo.

Banding an Armature Without Removing It from Frame

One of our 50-kw. engine-driven generators began to flash at the commutator and upon shutting the machine down it was found that the middle band on the armature had broken and parts of it came out on the commutator and brushes. The generator was directly connected to the engine, consequently it would have been a considerable job to remove the armature to put the new band on, therefore it was decided to try to put on the band with the armature in place. The polepieces were bolted to the frame with bolts from the outside. This made it possible to remove the bolt from the top polepiece and take the latter out, as shown in the figure. Two wood clamps were used to hold tension on the band wire. One of these clamps was fastened to a piece of timber between two posts about 5 ft. away from the machine and the other was fastened against one polepiece inside the machine, as in the figure, and used to direct the wire on the armature. With one end of the banding wire fastened to a coil where it projected beyond the core, the armature was turned by hand and three or four turns were put on the armature, to gradually bring the banding wire over to the position of the



GENERAL ARRANGEMENT OF PARTS FOR PLACING BAND ON ARMATURE

band. The wire was then placed in the clamps and the latter adjusted to give the proper amount of tension. On the first turn of the new band the armature was worked around very carefully and the mica insulation and copper binding clips put in place; after this the remainder of the band went on easily. After soldering all around and removing the loose ends of the band, the polepiece was put back into place. The machine has been in service for a number of months now, and the band is still giving service and shows no signs of moving. S. NYGREEN.

New York City.

Another Long Run

I read with interest the record run of a steam turbine, as published in the May 15 issue. We have an 875-kw. 600-r.p.m. generator directly connected to a waterwheel operating under a head of 170 ft. This unit ran from Dec. 15, 1919, to April 18, 1920, a total of 126 days, without being shut down for any purpose whatever.

Copenhagen, N. Y. V. C. WOOD.

Shaft Lubrication

With reference to recently published articles in *Power* on the subject of self-oiling bearings, I would say that I have also found the ring-oiled type of bearing to be generally efficient, but it is obvious that the use of that method of lubrication on the larger sizes of bearings is not practical.

It has been my experience, with chain-oiled bearings as large as 20-in. running 120 r.p.m. and 12-in. bearings running between 150 and 200 r.p.m., to find that the difficulties encountered in that method are usually caused by tight links, broken pins or chains not being of proper length. I have found chains long enough to drag on the bottom of the oil well, and in other cases the adding of a few links to a poorly running chain has increased its traction and caused it to run steadily.

Before putting a new chain in service for this work, it is always well to examine each link carefully to make certain that it doesn't bind excessively, as a tight-fitting link will offset the chain after it passes over the shaft, and if it does not straighten itself out before coming up on the other side, the offset formed will stop the chain.

Another point that requires attention is the matter of joining the ends of a chain after placing it around a shaft. This joint is often made with copper or other soft-metal wire, which if used on an iron chain will wear out in a comparatively short time and allow the chain to part, perhaps at a critical time. The pin used at that joint should be equal in strength to all others used in the chain. Without observing these small precautions, the chain method of oiling cannot be said to be dependable.

I entirely agree with the statement in the April 6 issue of *Power* to the effect that ring-oiled bearings should be watched when they are started, to see that the rings start with the shaft, but I have known of several instances where oil rings have stopped while the shafts were revolving. In my experience this has occurred most frequently with slow- and variable-speed shafts and it is almost always caused by some defect in the ring, such as high or low places where the ring ends are joined or by the ring being bent out of a true circle.

In one instance a ring on a 4-in. shaft was found chattering and jumping clear of a motor shaft so rapidly as to allow practically no oil to be carried to the shaft. When this motor was slowed down to about one-half normal speed, the ring immediately came down on the shaft, ran steadily and carried plenty of oil. Upon raising the oil level in this bearing about $\frac{1}{4}$ in., the ring operated properly at all speeds of the motor.

On another occasion considerable trouble was experienced by the frequent stopping of a ring on a 3-in. shaft of a compressor running at 200 r.p.m. This ring gave no trouble during the first three years of its use. When the trouble first occurred, it was found that the ring would run very slowly for about one-half revolution, then speed up, only to slow down again and finally stop after running about half an hour. Close examination revealed that the ring was sprung to a slight oval form, barely noticeable without measuring. After truing the ring, it ran satisfactorily a few weeks and then began an erratic action again. A second investigation showed that the ring had again sprung to an oval form and would hang up when one of the long ends of the oval reached the top of the shaft, although the distortion of the ring in this case was scarcely more noticeable.

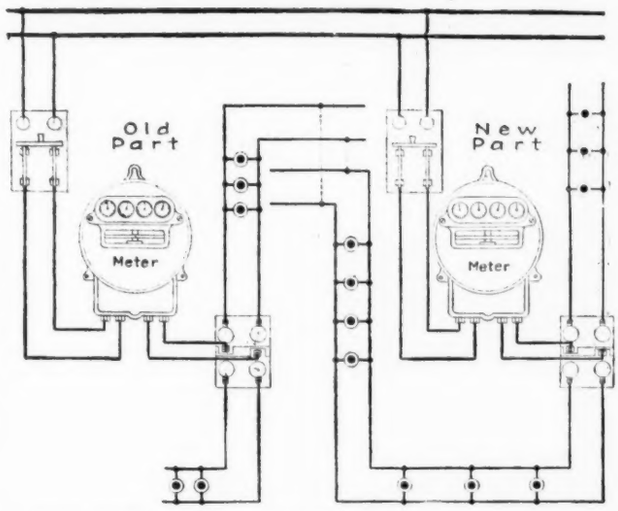
A permanent remedy was thereupon effected by filing away part of the metal on the inside of the ring, to bring it as nearly as possible to a true circle without having to again spring it.

Careful examination will, in most cases, show the reason for a ring-oiled bearing failing to give satisfaction as to economy and continuous service.

Jersey City, N. J. I. S. CHAMBERLAIN.

A Peculiar Meter Problem

Victor H. Todd's metering problem in the April 6 issue of *Power* brings to mind a condition that prevailed on our system for a time some years ago, before twenty-four hour service was given. A building was wired and connected to the secondary street mains through a service meter, and later a new part was built on and connected to the same mains through another service and meter, as shown in the diagram. In order to furnish power in the new part before the service was installed, the wiremen connected the two circuits together as shown by the dotted lines in the diagram. Since no day service was given, the electrician who



HOW THE TWO CIRCUITS WERE INTERCONNECTED

installed the meter did not notice that the new part was alive, and it was only by mere chance that the connections were made so that no fuses blew when both service switches were in and the current on.

It was noticed that the meter readings were not commensurate with the loads, although tests with portable instruments and a separate load showed that both meters were correct. On replacing the fuse plugs and connections after testing the last meter, it was observed that this meter hummed with the main switch out, which showed that current was flowing in its potential coil, and upon turning on a light near-by the presence of current was proved. This started an investigation that disclosed the cross-connections between the two circuits. It so happened that the new service was made as shown, thus connecting one end of the through circuit of the new meter to the same main as one end of the series side of the old meter, while the through side of the old meter was likewise connected with reference to the series side of the new meter. Upon tracing the circuits, it can readily be seen that by means of these connections the through circuit shunts the series coils of the meters. Upon removing the cross-connections, the meter ran correctly. HENRY MULFORD.

Patchogue, L. I.

Care of CO_2 Recording Machines

In reading the article by G. A. Chatel, on page 784 of the May 11 issue, I am pleased to learn that Mr. Chatel's experience with CO_2 machines is so nearly like my own. For example, he estimates that about one-half hour per week is required for changing absorbent cartons and general cleaning, which agrees nearly with my own estimate, as stated in the Feb. 17 issue. Also, Mr. Chatel "does not consider it good economy to put a high-priced mechanic on the job;" in other words, the machines are in charge of a man "not necessarily a first-class mechanic, but rather one who has specialized in the care and operation of these particular machines."

On one point, however, Mr. Chatel disagrees with me, claiming that one man spends on an average one-half hour per boiler per day for routine testing, checking and adjusting, whereas I estimated three or four minutes daily for this work. Certain CO_2 recorders include means for checking for accuracy, and if several units are checked at one time it is possible to complete this work by devoting an average of three or four minutes to each machine. Evidently, in Mr. Chatel's plant, they check frequently against an Orsat and make a very thorough job of the whole proceeding. While such thoroughness is not absolutely necessary to satisfactory performance, it is nevertheless commendable and the extra time required is undoubtedly effort well spent in the long run.

In the last paragraph Mr. Chatel refers to the lag of five to ten minutes in the time required for the gas to reach the machine and become analyzed. The amount of the lag depends on the location of the analyzing machine. Naturally, the farther it is from the boiler the greater will be the lag; hence it is advisable to install the analyzing machine as close to the boiler as practicable. A new type of CO_2 instrument has recently been introduced in which the lag has been greatly reduced. This result is accomplished by employing two aspirators for drawing the gas sample instead of one, as was formerly the practice. The auxiliary aspirator employs the exhaust steam from the primary aspirator, hence the newer arrangement is also more economical.

The only lag in any event is during the travel of the gases from the flue to the analyzing machine. There is practically no lag in actuating the CO_2 recorder in the chief's office or the auxiliary CO_2 indicator on the boiler front irrespective of the distance of these instruments from the analyzing machine.

Mr. Chatel states that CO_2 recorders are "very useful in keeping efficient fires, as a man who is experienced can judge very closely the condition of the fire by the percentage of CO_2," but adds that an ideal installation would be a combination of CO_2 equipment and recording pyrometer on each boiler, if price were not prohibitive.

This is indeed the ideal combination. Furthermore, the price is really not prohibitive excepting on small boilers, or where fuel is very cheap. For example, one type of equipment is made in this combined form. It records CO_2 and temperature on the same chart, which is an advantage because the two readings can then be more readily correlated. Combined equipment of this sort for a battery of four boilers with individual recorders for each costs about $400 per boiler. Assuming a monthly cost of fuel amounting to $1,000 per boiler, it is apparent that as little as 5 per cent saving in fuel resulting from the use of the combined pyrometer and CO_2 instrument would return the initial cost of the instruments in considerably less than a year. After returning the initial investment, the future savings would be almost clear profit. If, however, there is any question as to the amount of available funds or whether the size of the plant would warrant a combined pyrometer and CO_2 recorder, a CO_2 recorder alone, being much cheaper than the combined outfit, would undoubtedly pay for itself in a very short time anyway.

New York City. C. J. SCHMID.

Industrial Unrest

On page 782 of the May 11 issue, I read with much interest what Mr. Crawford had to say on "Industrial Unrest." Perhaps we who work in the textile industry know a thing or two of this same unrest. We get the question, "When is the next raise coming?" fired at us from all points of the compass every hour of the twenty-four. Our power-plant workers go around with "chips" on both shoulders, and we beg our assistants to be careful and do nothing to explode the charge within.

Engineers get together, as Mr. Crawford says, and the weak want the support of the strong and in some cases get it. I was surprised one day to find that not one of my engineers knew how a boring bar was "set," yet they were all shouting their individual qualifications.

I have never asked the "boss" into my office to talk over mill work. My men have to come to my office when they want something. My time is taken up, not for eight hours a day, but sixteen hours, sometimes, and unless supervising repairs, my place is generally in my office. The "boss's" place is generally in his office, and it is a no longer walk from my office to his than from his to mine. He is older by some years than myself and deserves some courtesy, which I try to extend to him. I never go to his office in my overalls, even if they are "paid for." I wash myself as clean as possible and try to look as decent as his other visitors.

Before the war began I had my salary voluntarily advanced over 100 per cent in a short term of years. I did not feel that I was the equal of the man higher up, but that I was a kind of understudy. I believe that "all men are created equal," but it is a fact that they do not stay so. The assistant in a certain plant often remarked, "If I ever get to be chief, I'll show the 'old man' a thing or two." In the course of time the old chief retired and the assistant was promoted to his position. He lasted just about three months. The old chief always said, "yes sir," "no sir," "thank you," etc., to his superior. The new chief said, "sure" and "nope," but never "thank you." He never "slicked up" to go to the office.

One of the office girls remarked to me one day: "The assistant engineer who took your place a few years ago has been made chief, and there'll be a good job for somebody soon, because he can't last. He never washes his face or takes off his overalls and I don't believe the 'boss' will stand for it." And he did not.

The reason I am writing this is because I feel that we have a large body of young readers and I want them to get both sides of the issue. The army, the navy and every ship has a superior officer. He is not necessarily a grouch, but he is in command.

Your plant, my plant and the other fellow's plant must have a superior officer, and the place to thresh out your troubles is in his office. C. W. PETERS.

New York City.

INQUIRIES OF GENERAL INTEREST

Alloy for Metallic Packing Rings.—What is a good composition of soft metals for piston-rod packing rings?
W. B. R.

For casting metallic packing rings good results have been obtained, using an alloy consisting of lead, 83¾ per cent; tin, 8¾ per cent; antimony, 8¾ per cent. For use with superheated steam tin should be omitted on account of its low melting point with the alloy composed of 80 per cent lead and 20 per cent antimony.

Less Grate Area with Stokers than with Hand Firing.—Why are the grate areas of stokers usually made less than the areas of hand-fired grates for the same furnaces?
W. N. J.

The motion of the stoker maintains a cleaner fire by constantly disturbing the film of ash formed by the burning coal. The rate of combustion attainable per square foot of grate is thus increased to an extent that more than compensates for the smaller grate area.

Conversion of Baume Degrees to Specific Gravity.—How is the specific gravity of a liquid estimated from the number of degrees Baumé?
G. A. W.

To convert degrees Baumé into specific gravity the following formulas are used:

For liquids lighter than water:

$$Sp.\ gr. = \frac{140}{130 + deg.\ Be.}$$

For liquids heavier than water:

$$Sp.\ gr. = \frac{145}{145 - deg.\ Be.}$$

Grooving of Boiler Shells.—What is grooving of a boiler shell, and by what is it caused?
F. R.

Grooving is internal corrosion or rusting away of the boiler shell in the form of grooves or cavities. Corrosion of this kind generally may be attributed to local changes of shape of the boiler shell due to changes of pressure or temperature. Slight movements loosen particles of skin or rust, and fresh surfaces are exposed for the formation of more rust. Corrosion, thus forming grooves or cavities, proceeds rapidly in such places as at sharp corners of head flanges, in the lower part of the water legs of locomotive and of vertical boilers, especially when fitted with mud rings, and along the side seams of cylindrical shells that are made with lap joints as a result of the bending that occurs in a lap seam when under pressure.

Sloping Floor of Combustion Chamber.—In the setting of a horizonal return-tubular boiler, what is the advantage of having the floor of the combustion chamber extended with a slope downward from the upper part of the bridge wall to the rear of the setting?
D. M.

There is no advantage in sloping the floor beyond obtaining greater convenience for drawing soot and cinders with a hoe toward the rear of the setting when cleaning out the combustion chamber. It is desirable to have thorough mixture of the gases before they reach the return connection of the setting, and for that purpose more favorable eddying of the gases is obtained by having the combustion chamber begin with a deep drop below the top of the bridge wall.

Designing Angle of Advance of Eccentric.—Why is the angular advance of an engine eccentric referred to the position of 90 degrees with the crank in place of designating the whole number of degrees in advance of the crank?
W. R. T.

The 90-degree position is taken as the basis for consideration, because in the simplest form of valve, without lap or lead, that position is necessary for admission of steam to one end or the other end of the cylinder, and departures from that form of valve or its operation are naturally referred to the 90-degree position of the eccentric, and "angle of advance" is commonly so understood. When otherwise intended, the angular advance should be specified as degrees "ahead of the crank."

Saving from Use of Feed-Water Heater.—What is the percentage of saving by the use of an exhaust steam feed-water heater where the boiler pressure is 90 lb. gage and the feed water is heated from 50 deg. to 170 deg. F.?
R. A. B.

By referring to steam tables it may be seen that a pound of dry saturated steam at the pressure of 90 lb. gage, or 90 + 15 = 105 lb. per sq.in. absolute, contains 1,187.2 B.t.u. above 32 deg. F. When the feed water is at 50 deg. F., or 50 — 32 = 18 deg. above 32 deg. F., for conversion into steam, each pound of the feed water requires 1,187.2 — 18 = 1,169.2 B.t.u. If the feed water has a temperature of 170 deg. F., then for its conversion into steam each pound would require 170 — 50 = 120 B.t.u. less than when the temperature is 50 deg. F., and if the feed-water heater is operated without increasing back pressure on the engine, the saving would be 120 ÷ 1,169.2 = 0.1026 or about 10¼ per cent.

Setting Steam Valves of Duplex Pump.—What is the method of setting the steam valves of a duplex pump?
J. R.

First, place the pistons of each side of the pump at the centers of their strokes by moving them first to contact with one head and then to the other, marking each position on the rods against the stuffing-box glands. Then, on each rod, place a mark midway between those marks and move the rod until this central mark comes against the gland. When this is done on both sides, the pistons are in central positions, and the valve-motion rocker arms that connect with the crossheads should stand perpendicular to the piston rods. If for either side this is not the case, the cross head must be disconnected and fixed at such a position as to correct the position of the arm. Now, remove the steam-chest covers and place the slide valves centrally over the ports and adjust the lost motion of each valve so there will be the same clearance at each end. If, upon trial of the pump, a steam piston strikes the head of its cylinder, take up some of the lost motion; if the piston does not make a full stroke, give more lost motion.

[Correspondents sending us inquiries should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications.—Editor.]

"The Great St. Lawrence"

"The Great St. Lawrence" was the subject of the evening at the final session of the season for the Chicago Section of the American Society of Mechanical Engineers at a dinner meeting held at the Chicago Engineers' Club on the evening of June 8 Before proceeding with the main topic, a brief report of the St. Louis spring meeting was made by the chairman, A. L. Rice. Formal notification was given that the next spring meeting of the society would be held in Chicago and the necessity for beginning preparations immediately instead of waiting until next spring was emphasized.

The following list of officers, presented by the nominating committee for next season, were elected unanimously: Chairman, H. S. Philbrick; vice chairman, W. O. Moody; secretary, J. D. Cunningham; two members of executive committee, G. W. Hubbard, D. Lofts. There was also a report on the conference held in Washington for the purpose of organizing a national federation of engineering societies. A full account of this meeting appears in the June 15 issue of *Power*.

An interesting talk on the possibilities of the St. Lawrence River from the standpoint of navigation and power development was given by H. C. Gardner, president of the Great Lakes-St. Lawrence Tidewater Association. The fact that the basin of the Great Lakes was not settled for 200 years after the discovery of this country was laid to the impediment to navigation, such as the rapids and Niagara Falls.

Just as the World War began, a committee had been appointed from this country to confer with the Canadian government with the purpose of improving navigation on the St. Lawrence. The war stopped all proceedings, but a year ago the Great Lakes-St. Lawrence Tidewater Association had been formed to take up the work of bettering navigation and considering the possible power developments. The international joint commission appointed eleven years ago by this country and Great Britain is also investigating the same problem.

The speaker outlined a territory starting from the St. Lawrence, cutting down through Maine, New York State and Pennsylvania, continuing along the southern borders of Kentucky, Missouri, Kansas and Colorado, and then north to include the States of Colorado, Wyoming and Idaho to the Canadian Border. This territory he represented as the heart of the country, containing more than one-third of the population and considerably more than one-third of the wealth. In this territory he indicated the centers of productivity and production; that is, of manufactured articles and food products. He pointed out the immense advantage water transportation would impart to this territory, which was within easy reach of the Great Lakes, and what it would mean for the development of this section. According to estimates it would require six billion dollars to do what must be done for transportation if the country is to progress. Even if the money could be obtained, the work could not be done fast enough. It would be possible, however, to improve the St. Lawrence for a comparatively small part of the money needed by the railways, and the improvement would be effected in a comparatively few years.

Some of the numerous advantages of ocean vessels coming through to Chicago were enumerated. Upon the supposition that we were exporting 3,000,000 bushels of wheat, it would be possible to save a minimum of 6c. per bushel, amounting to $18,000,000. As a matter of fact, the railways had employed differentials as high as 20c. to protect against contingencies in shipments to Liverpool.

Some of the objections raised by opponents to this movement were that the Great Lakes and the river were icebound a considerable part of the year. It was pointed out that the Great Lakes were open for navigation 244 days in the year and closed 121 days; that the Detroit River carried 90,000,000 tons of freight per annum, which was ten to fifteen times greater than the amount passing through the Suez Canal, the inference being that enough traffic could be taken care of in the eight months available to warrant many times over the expenditure that would be necessary.

With reference to the power developments possible, it was stated that between Lake Ontario and the Lachine Rapids at Montreal, a stretch of 150 miles, the total fall was 221 ft., and the flow of 240,000 sec.-ft. was phenomenally uniform, there being a variation of only 25 per cent between the mean and the maximum, which might be compared to 30 to 1 at Keokuk, on the Mississippi, and similar variations for other rivers of the country.

With this fall and flow it was possible to develop 5,750,000 hp. At 70 per cent efficiency the total would be reduced to 4,000,000 hp. About one-third of this power was available in the international part of the river, and the balance in Canada. If the expense of developing the international part of the stream were shared equally and the power divided, there would be available to the United States about 800,000 hp., and if this country shared in the entire project, about 2,000,000 hp. would be available.

From the conservation standpoint, allowing twenty tons of coal per horsepower-year for steam generation, the 800,000 hp. would save 16,000,000 tons of coal per year. The total development of the 4,000,000 hp. would save 80,000,000 tons of coal per year, which would be increased to 100,000,000 tons by including the 20,000,000 tons of coal that would be needed to transport all of this fuel by rail. This is approximately one-sixth of the total amount of coal used in this country last year for all purposes. Besides, there would be the man-power saved in the mine, on the railway, in the distribution of the coal to the ultimate consumer, and the men that would be required to fire the coal in a steam plant.

From the standpoint of navigation, power development and conservation it would be one of the best investments this country ever made to unite with Canada and improve the St. Lawrence.

Engineering clubs and societies, manufacturers' associations, commercial organizations, technical schools, and the educational departments of large corporations will be interested in the announcement that the Diamond Power Specialty Co., Detroit, Mich., now has available for free distribution three copies of its motion picture, "Coal is King." The film was originally prepared as part of the coal conservation campaign used during the war, but has just been completely revised and brought up to date, all war material being eliminated and much new material added. The film deals with good and bad methods of coal mining and transportation, good and bad methods of firing, combustion losses and their minimization, power-plant instruments such as draft gages, CO_2 recorders and their uses, losses caused by leaky boiler settings, good and bad management of the boiler room, and the necessity for keeping the boiler surfaces clean is properly brought out. Pictures of scale and soot removal, losses caused by firing the boiler too high or too low above or below rating, losses caused by cutting in stand-by boilers too early or too late, losses caused by uncovered steam pipes, leaky pipes, steam traps, etc., are shown. The film is in four reels, requiring approximately fifty minutes to be shown. Bookings are now being made for the summer and fall, and those interested should make their reservations without delay in order that schedules may be completed.

Hearings on the proposed amendments to the New York state industrial code relative to the construction, installation, inspection and maintenance of steam boilers were recently held by Deputy State Industrial Commissioner Thomas C. Eipper, who explained that the proposed amendments were prompted by changes recently adopted by the American Society of Mechanical Engineers. Among the proposed changes discussed were: Requirement that boilers under state jurisdiction be inspected internally once a year and externally twice a year; that the commission revoke the licenses of inspectors for incompetency or untrustworthiness after a hearing; that applicants for inspectorships have five years' practical experience before being eligible and that certificates of inspection of portable boilers be kept near the boiler at all times.

What a Definite Federal Water-Power Policy Will Mean

When President Wilson affixed his signature to the Water-power Bill it put into effect what is admitted to be one of the most important pieces of legislation of recent years. It marked the culmination of the fight which has been in progress since 1890, to establish a Federal water-power policy. That the provision for a definite method by which water powers on the public lands and on navigable rivers will have a decided bearing on the entire power situation of the country is admitted. It is estimated that every water horsepower that can be substituted economically for a horsepower developed from fuel would represent a saving of approximately five and one-half tons of coal per year. This calculation is based on a twelve-hour day. It is further calculated that the labor of one man is released for other uses every time fifty hydro-electric horsepower is developed, while one freight car is saved for other use for each 150 horsepower which may be developed hydro-electrically.

Sixty Million Horsepower Available for Development

The United States Geological Survey, which has made the only pretentious survey of potential water power of the country—and the estimates necessarily were purely approximations—believes that more than sixty million horsepower is available for development. Interest in water power naturally is greatly stimulated at this time by the increased cost of coal and the certainty that great restriction must come in the use of fuel oil for steam-making purposes.

While it is realized that the utilization of the country's maximum water-power resources is a long way in the future, even the ultra conservationists admit that there would now have been twenty-five million developed horsepower rather than the five million which exists, had it not been for lack of satisfactory legislation.

Originally there were two types of water-power bills being urged. One involved the use of power on navigible streams and the other the use of power on public lands and reservations. The more the matter was discussed, however, the more evident it became that the same basic principles must prevail, and finally the idea of separate administration for public-land water powers and navigible-stream water powers was abandoned. To accomplish that, the committees on public lands joined with the committees having to do with commerce in formulating the legislation for joint administration. It may be mentioned, however, that throughout its entire course in Congress, the bill never has been a partisan measure.

The outstanding feature of the Water-power Act is its valuation provisions which establish bases for the purposes of rate-making or sale. The fundamental principle is that the investor who puts an honest dollar into a water-power project can make an honest profit on that dollar and get the dollar back, if he desires at the end of the license period. It is believed that inflation has been sufficiently guarded against, and valuations at the beginning will make impossible the type of exploitation which accompanied land grants to the railroads. Everything possible has been put into the bill to take the gamble out of water-power development.

Machinery orders, running high in the millions, are understood to have been placed contingent upon the passage of this water-power legislation and, as the bill is regarded very generally as being sufficiently liberal to attract capital, fairly rapid development is anticipated.

Federal Power Commission

The act provides for a Federal Power Commission to be composed of the Secretaries of War, Interior and Agriculture. These secretaries are directed to appoint an executive secretary and may request the President to detail to the commission an engineer officer to assist in the administration of the law. The duties and functions of the commission may be classified under seven general heads, as follows: (1) General administration of water powers; (2) design, construction and operation of project works; (3) regulation of financial operations; (4) regulation of rates and service; (5) valuation of properties of licensees; (6) general investigations; (7) special investigations.

In the general administration of water powers the more important duties placed upon the commission are the following: To issue licenses for power projects and transmission lines; to issue preliminary permits to power projects; to provide for proportionate distribution of annual costs of headwater improvements between owner and licensees benefited thereby; to assess against all licensees benefited the annual costs of any headwater improvement constructed by the United States; to prescribe rules for and to fix annual license charges and to determine the relation of such charges to prices collected from consumers; to make rules and regulations for the administration of the act.

The commission has authority to pass upon the general scheme of development of power sites, upon the plans and specifications of the works and upon certain features of maintenance and operation of project works. This includes the duty to require project works to be properly maintained and kept in efficient operating condition, and to keep in touch with conditions of the power market tributary to every development, in order to require extensions as rapidly as conditions warrant. In addition, the commission is charged with the preparation of a comprehensive plan of development in connection with each power project, which shall take into account full utilization of the stream for the purposes of navigation, water-power development and other beneficial public uses.

Under the provisions of the act, the commission must require the submission of financial statements and reports; to regulate under certain conditions the amount and character of securities which may be issued for the financing of power projects; to prescribe rules for the establishment and maintenance of depreciation reserves; to devise principles for the proper apportionment of surplus earnings to amortization reserves.

Jurisdiction over the regulation of rates and service is placed in the hands of the commission whenever the state has no agency to look after regulation or whenever the states concerned do not have power to act individually or cannot reach a mutual agreement.

Valuations To Be Based Upon Investment

One of the fundamental principles of the act provides for valuations for the purpose of rate making or of purchase at the termination of the license period. Valuations are to be based upon net investment in the property which are to be determined either through a system of accounting or through physical valuation. For those purposes the commission is directed to require the filing of statements showing the cost of construction of project works and the price paid for water rights, rights of way, lands and interests in lands. This involves also the making of valuations of projects brought under license which have been constructed in whole or in part prior to the application for license. The commission must determine the net investment and severance damages in the event that properties of the licensee are taken over by the United States at the termination of a license period.

The commission is specifically charged to undertake the collection of comprehensive data concerning the utilization of the water resources of any region to be developed. It also is called upon to report on the water-power industry as a whole and its relation to other industries and to interstate and foreign commerce. Other investigations are also outlined. In that connection the commission is to hold hearings and may require the attendance of witnesses and the production of evidence.

The special investigations provided for in the bill include a report on the Great Falls power project, near Washington, on the Potomac and reports on all projects on navigable streams in which it appears that the construction of suitable navigation structures cannot be undertaken by the applicant for license.

It is recognized that the three Cabinet members necessarily can devote little time to the administration of the new law and that the entire responsibility rests with the executive secretary. It has been rumored that the secretaries in-

tend to appoint to this important position Oscar C. Merrill, now the chief engineer of the Forest Service. In that position Mr. Merrill has had jurisdiction over the use of water powers in the forest reserves. His long service in that capacity has given him more opportunity than to any other man in the country to come into contact with the practical problems presented in the administration of water-power matters. In addition, Mr. Merrill is regarded as an authority on water-power subjects, and it was he who drafted the bill which, with some amendments, has become a law.

The Iowa State N. A. S. E. Convention

The annual convention of the Iowa State Association of Stationary Engineers was held in Dubuque, June 16 to 18. O. C. Carr delivered an address of welcome to the delegates. F. W. Raven, national secretary of the N. A. S. E., William Lyons, president of the Central States Exhibitors' Association, and Royal H. Holbrook, state deputy, answered on behalf of the visitors.

Papers were read by T. C. Messplay, engineer of the International Filter Co., on "Water Treatment and Scale Prevention," and John M. Drabelle, mechanical and electrical superintendent of the Iowa Railway and Light Co., on the "Qualifications of an Engineer." In the afternoon the A. Y. McDonald Manufacturing Co., makers of pumps and plumbing supplies, entertained the delegates. In the evening, A. M. Pritchard, of the Vacuum Oil Co., read a paper on lubrication, illustrated with lantern slides. On Friday morning the regular election of officers was held, resulting as follows: President, Harry G. Hammond, of Davenport; vice president, A. B. Elliott, Mason City; secretary, Abner Davis, Cedar Rapids; treasurer, James A. Coulson, Sioux City; conductor, William Meese, Marshalltown; doorkeeper, William Viggers, Des Moines; state deputy, Royal H. Holbrook, Cedar Rapids. Davenport was selected as the place for the next convention.

Fuel Section of the A. S. M. E.

One of the first professional sections to be authorized by the Council of the American Society of Mechanical Engineers is that upon Fuels. The organizing committee expresses itself with regard to the policy of the section as follows: "It is the firm conviction of this committee that the work of the Fuels Section should be carried out for the benefit of the country and fuel-consuming communities at large, and not to foster any specific interest of either industry or trade."

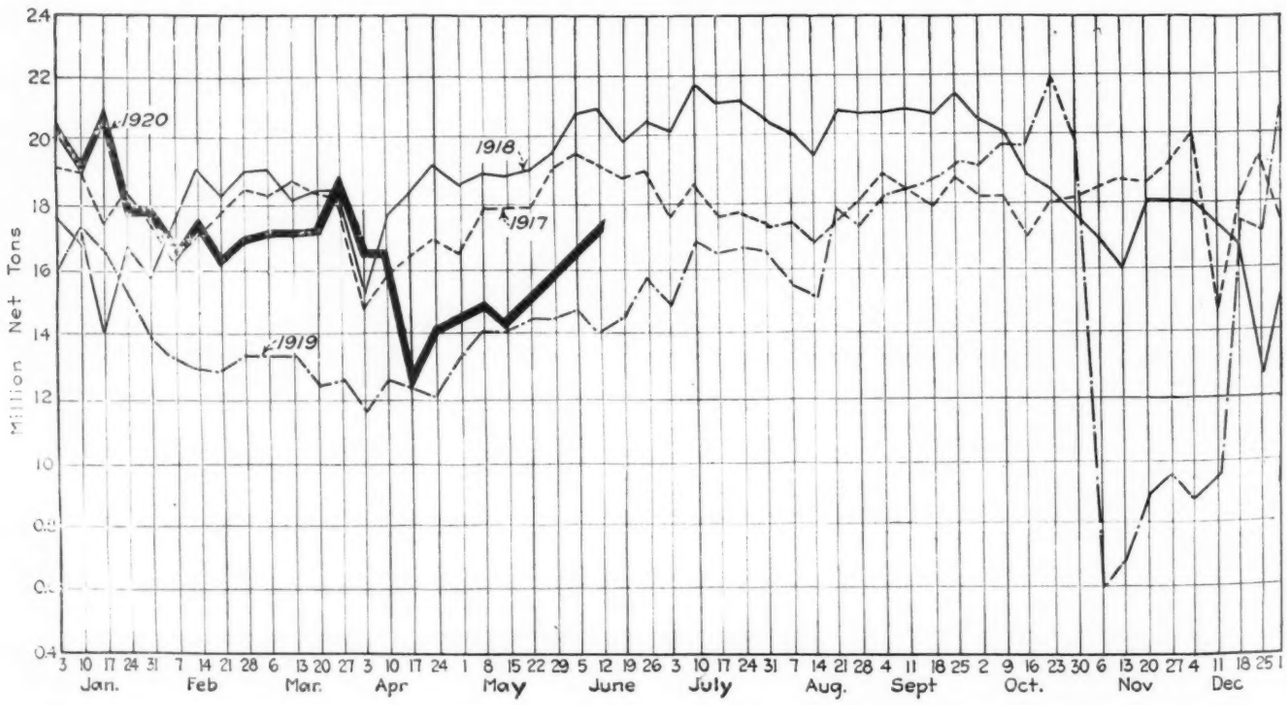
The section has been organized by the election of Prof. L. P. Breckenridge, chairman; Prof. G. F. Gebhardt, vice-chairman, and F. R. Uehling and Joseph Harrington to serve with the chairman and vice-chairman as an executive committee. A meeting of this executive committee was held at the rooms of the society on June 9, at which a Committee on Meetings and Papers and another on Publicity Information were appointed. It is hoped that the section will take an important part in the program at the annual meeting in December.

Power Survey Authorized

The United States Geological Survey has been authorized by the Sundry Civil bill to proceed with the super-power survey for the industrial region, Boston to Washington, and by the bill is given $125,000, together with authority to receive additional sums which may be contributed to the work. This survey will include a study of the possibilities of water power in contrast with coking of coal and steam-power plants, both at the mine and at seaboard. It is anticipated that several experts of wide experience will be engaged by the Survey to direct the investigation.

Whitfield P. Pressinger

Whitfield P. Pressinger, New York, vice president, Chicago Pneumatic Tool Co., died June 10 as a result of complications following an operation. Mr. Pressinger was actively engaged in the pneumatic tool and allied machinery industry for many years. He was general manager of the Clayton Air Compressor Co. for seven years and became widely known through numerous activities in the American Society of Mechanical Engineers and the Compressed Air Society. He was born in New York City in 1871. In addition to the foregoing societies he was a member of the Sons of the Revolution, Seventh N. Y. Regiment Veterans, F. and A. M., and the following clubs of New York City: Engineers, Lawyers, New York Athletic, New York Railroad, Columbia Yacht, and the Machinery Club.



ESTIMATED AVERAGE TOTAL PRODUCTION PER WORKING DAY OF BITUMINOUS COAL INCLUDING COAL COKED

Coal Market Still Chaotic

For the last year and a half or two years a column of coal prices has appeared weekly in *Power*. The present situation in the coal market, however, is so impossible to describe by mere figures that a weekly discussion will be substituted in place of the tabulation. A paragraph or so will be devoted to conditions in each of the principal cities.

New York: The demand for anthracite is heavier than the receipts, which are below normal for this season. Production is reported to be heavy, but in view of the effort being made to induce a stronger movement of bituminous it is feared that the car supply at the anthracite mines may be reduced. Of the steam coals, rice and buckwheat are the most active. The reason for the activity in steam coals is attributed to the high prices quoted for bituminous. Quotations for company coal per gross ton at the mines and f.o.b. New York tidewater at the lower ports are as follows:

Pea	5.85—6.25	7.60—8.00
Buckwheat	4.00—4.10	5.75—5.85
Rice	3.00—3.50	4.75—5.25
Barley	2.25—2.50	4.00—4.25
Boiler	2.50	4.25

In the bituminous market prices are higher than a week ago, the high level being the result of buyers bidding against each other in the coal fields. Another factor in the high prices is the heavy towing charge, tariff for boats alongside being about $15. It is reported that fair grades of Pennsylvania coal are quoted around $10.

Boston: The spot market on steam grades of bituminous continues its remarkable rise, the present price being nearly $12, with no sign of a decline. The heavy demand for soft coal has persisted for more than six weeks; wholesale offices are beseiged by buyers; middle-houses are purchasing from one another, and conservative consumers have ceased to wait and now are seeking coal at the best prices obtainable. The car movement appears to be improving, cars having reached New England from beyond Pittsburgh in less than ten days. Current wholesale prices on bituminous are about as follows:

	Clearfields	Cambrias and Somersets
F.o.b. mines, net tons	$9.75@$11.25	$10.25@$11.50
F.o.b. Philadelphia, gross tons	12.80@ 14.50	13.40@ 14.30
F.o.b. New York, gross tons	13.50@ 14.85	13.75@ 15. 0

Philadelphia: Moderate tonnages of anthracite continue to enter Philadelphia, but the fact that coal is being delivered to consumers as rapidly as it comes in is causing some uneasiness in the trade. Ordinarily, at this season there would be large stocks of pea coal, but there is an actual scarcity of this size today. For the past four years pea coal has been finding a widening use, with the West a heavy buyer. It is stated by the premium shippers that pea is selling as high as $9.75 at the mines.

The steam coals appear to be moving satisfactorily, with the exception of barley. There is a tightening in buckwheat, and the companies have all the business they can handle at $4 and $4.10. The independents are getting $4.25 to $4.50 for buckwheat, and are disposing of all produced. Rice is active, due probably to the scarcity of soft coal. There seems to be a tendency on the part of the big consumer to change over a portion of the boiler equipment, to take advantage of an over-production of barley with soft coal prices out of reason.

Although it is claimed that soft coal production has increased recently, mine prices have remained in the vicinity of $10, while sales at $11 have not been rare. The big producers have no coal for the spot market, most of them having difficulty in meeting contract obligations.

Cleveland: Following a conference with railway officials and the manager of the Ore and Coal Exchange, operators in No. 8 district, with headquarters in Cleveland, have sent an appeal to the Interstate Commerce Commission for means of "continuous operation of the mines," which can be accomplished only by an adequate supply of cars. Most plants continue to operate on a hand-to-mouth basis and extraordinary efforts are being made to obtain sufficient coal to avoid shut-down. As high as $8 is being offered by consumers, but stock supplies, even at that price, are almost unobtainable.

Anthracite coal is about the only grade obtainable from dealers' yards, and most retailers are accepting orders only for anthracite. There are practically no stocks of Pocahontas remaining, and retailers refuse either to quote prices or guarantee delivery. It is stated that the supply is only about 5 per cent of the demand.

Retail prices per net ton, delivered in Cleveland, are $13.20 for egg; $13.20 to $$13.50 for grate; $13.50 for chestnut and stove; $11.75 for Pocahontas shoveled lump, and $9.25 for mine-run.

Chicago: Coal continues to enter the Chicago market in very satisfactory quantities, so that the plants are in a position to be a little more discriminating in their buying. Prices vary widely in the different fields. Franklin County coal, perhaps the best produced in this territory, is selling at the fair prices shown in the tabulation:

Southern Illinois Franklin, Saline and Williamson counties:		Rate to Chicago
Prepared sizes	$3.50 to $6.00	$1.55
Mine-run	3.50 to 5.50	1.55
Screenings	3.25 to 4.50	1.55
Central Illinois Springfield District:		
Prepared sizes	$4.00 to $6.00	$1.32
Mine-run	4.00 to 5.00	1.32
Screenings	4.00 to 4.75	1.32
Northern Illinois		
Prepared sizes	$4.75 to $5.00	$1.24
Mine-run	4.50 to 5.00	1.24
Screenings	4.25 to 4.50	1.24

St. Louis: There is a shortage of steam coal and of high-grade domestic. In the Standard district, the mines continue to work about two days a week on commercial coal, although they make a considerably better showing where railroad coal is loaded. In the Carterville field, two days a week is the commercial run on the Missouri Pacific, and about three days' work a week on the other railways, with better time where railroad coal is loaded. The miners seem to be generally satisfied, and there is practically no labor trouble. The movement of cars throughout all the fields is slower than normal. Standard coal is quoted for St. Louis delivery at from $3.25 to $4.50 at the mines for domestic sizes, and at about the same price for screenings and mine-run.

Detroit: Steam and domestic buyers are having serious difficulties in obtaining supplies. Jobbers state that conditions are not improving and that the shortage of bituminous coal is as serious as ever. There is practically no free coal on the tracks, practically all stock going directly from mines to consumers. Although small shipments are coming from Illinois and Indiana, the market is practically dependent upon Ohio for its bituminous coal. Slack from Ohio is reported selling around $6.75 at the mines per short ton. Mine-run is quoted at $7 to $7.25, and lump is offered at $7.50. Jobbers report that the storage of cars is still preventing mines in nearly all districts from getting more than two or three days' production per week. Coal from West Virginia and Kentucky has all but disappeared from the market, and is received only in shipments applying on long-standing contracts. This coal, which was formerly the chief supply of Detroit manufacturers, is now being sent to tidewater, for prices are said to be at a level that render it impracticable for local buyers of steam coals to purchase it.

Birmingham: Reports indicate that coal is moving with fewer delays. Contract fuel mines are obtaining all the cars needed, while commercial operations receive from 45 per cent to 50 per cent of their requirements. Extremely warm weather has caused labor to slacken, with smaller production as the result. The principal work among the brokers and selling agencies is the declining of the great volume of orders. There is no coal available for handling additional business. The small amount of soft coal that enters the market is absorbed at prices ranging from $4.50 to $7 per ton mines, regardless of grade.

New Publications

PROPOSED WORK

N. H., Portsmouth — Kendall, Taylor & Co., Archts. and Engrs., 93 Federal St., Boston, Mass., will soon award the contract for a 2 story, 30 x 50 ft. boiler house, etc., for the Portsmouth Hospital, here.

Mass., Boston — The Edison Electric Illuminating Co., 70 State St., plans to build a power station on B'way.

Mass., Boston — The Schoolhouse Comn. will soon award the contract for the installation of new boilers and other changes.

Mass., Pittsfield — The General Electric Co. will soon award the contract for a 1 story, 100 x 400 ft. factory for the manufacture of electric specialties. Plans include a steam heating system.

R. I., Providence — The Packard Motor Car Co., B'way and 61st St., New York City, will soon award the contract for a 2 story, 190 x 205 ft. garage, service building, etc., including a steam heating system and electric power, on Plenty St. About $400,000.

Conn., Montville—The Robert Gair Paper Corp., Thames River Division, will soon award the contract for a 2 story, 250 x 100 ft. paper factory. Plans include a 1 story, 50 x 50 ft. power house. About $500,000.

N. Y., Buffalo — The Keystone Tool & Metal Parts Corp., 65 Oak St., is in the market for a 3 phase, 25 cycle, 720 r.p.m. 15 or 20 hp. motor.

N. Y., New York — The Dept. of Pub. Charities, Municipal Bldg., is in the market for refrigerating machinery for the New York City Home on Blackwell's Island.

N. Y., Yonkers — The Yonkers Electric Light & Power Co. plans to construct a substation. About $150,000. W. Whitehill, 55 Duane St., New York City, Archt. and Engr.

N. J., Newark — J. H. and W. C. Ely, Archts. and Engrs., Fireman's Trust Bldg., will receive bids about July 1 for a 4 story, 140 x 200 ft. recreation building including a steam heating system, on Clark and Ogden Sts., for the Clark Thread Co., Clark and Ogden Sts. About $350,000.

N. J., Trenton—The City Comn. will soon receive bids for installing a 25,000,000 gal. pump and a 1,000 hp. generator to be driven by a steam turbine for the city waterworks. About $75,000. J. R. Fell, engr.

Pa., Ford City—The City Clerk will soon award the contract for a reservoir and a power house addition, etc. Douglas & McKnight, Columbia Bank Bldg., Pittsburgh, Pa., Engrs.

Md., Baltimore—Lockwood Green & Co., Archts. and Engrs., 101 Park Ave., New York City, will soon award the contract for a 4 story, 80 x 222 ft. factory including a steam heating system, for MacCawley & Co., 400 Exch. Pl. About $650,000.

Va., Hampton Roads — The Bureau of Yards & Docks, Navy Dept., Wash., D. C., received bids for an underground steam heating system at the naval operating base here from John R. Proctor, 74 Courtlandt St., New York City, $19,380; M. A. Dane & Son Co., 28 Buffum St., Lynn, Mass., $22,000. Noted March 30.

N. C., Newton—The Citizens Cotton Mill is in the market for one 250 hp. engine and one 125 hp. r.t. boiler. (used).

Tenn., Chattanooga — The Brock Candy Co., 1113 Chestnut St., plans to build a power house and install a 300 hp. boiler, air compressors, etc.

Tenn., Clarksville — The Kentucky Pub. Serv. Co. plans to build an auxiliary electric power plant. A. D. Couch, Engr.

Tenn., Nashville—J. W. Dashiell, Secy., will receive bids until June 30 for the designing and construction of a 20,000,000 gal. turbine-driven centrifugal or steam actuated equivalent condensing high service pumping engine and two 20,000,000 gal. low service centrifugal pumps to be engine or otherwise driven, for the city.

O., Akron — The City Council contemplates issuing $1,000,000 bonds to construct and maintain a power plant.

O., Akron—E. A. Zeisloft, Dir. of the Pub. Serv., Delaware Bldg., will receive bids until July 9 for the construction and equipment of an addition to the water purification plant here. Motor driven pumps and other auxiliary equipment will be installed in same.

O., Cleveland—The city will receive bids until July 2 for furnishing and installing two 8,000,000 gal. and one 4,000,000 gal. motor driven vertical centrifugal pumps with motors, electrical equipment, etc. About $25,000. E. Shattuck, Agt. G. B. Gascoigne, City Hall, Engr. Noted June 22.

O., Cleveland—The city will receive bids until July 2 for 1 motor driven power house type coal crusher. E. Shattuck, City Hall, Agt.

O., Cleveland — The Comr. of Purchases and Supplies, 219 City Hall, will receive bids until July 2 for furnishing and installing 3 motor driven vertical centrifugal pumps with motors, electrical equipment, etc.

O., West Carrollton—The Miami Paper Co. is having plans prepared for a 1 story, 20 x 28 ft. boiler house addition. One 150 hp. boiler will be installed in same. About $10,000. W. D. Spangler, Marshall Bldg., Cleveland, Archt. and Engr.

Mich., Detroit—The Kirby Ave. Development Co., c/o Smith, Hinchman & Grylls, Archts., 710 Washington Arcade, plans to build a 2 story service station on Kirby Ave. About $150,000.

Wis., West Bend—The West Bend Heat & Light Co. plans to build a 113 x 150 ft. power plant and extend its transmission lines to Kohlsville, Newburg and Fredonia stations. About $80,000.

Minn., Albert Lea—The City Clerk will soon award the contract for furnishing 2 motor driven centrifugal pumps with automatic control, 2 air compressors, 2 motors with belt drive and 1 horizontal driven double suction centrifugal pump to have a capacity of 800 gal. per minute against a 50 ft. head direct connected to one 14 hp. steam turbine. R. G. Lindgren, Engr.

Minn., Buhl—Louis Ruchstadt, Clk., will soon award the contract for a 3 story, 180 x 200 ft. high school addition including a steam heating and mechanical ventilating system, on Main St., for the School Bd. About $350,000. A. W. Kerr & Co., Chestnut St., Virginia, Minn., Archt. and Engr.

Kan., Cullison—The city will soon award the contract for a transmission line from here to Pratt. About $15,000. L. M. Hutchison, Clk.

N. D., Bismarck—The Bd. of City Comrs. will receive bids until July 12 for a complete waterworks system including a steam heating system in the proposed filtration plant.

Miss., Shubuta—The city plans an election July 13 for the purpose of submitting to the voters a proposition to issue $12,000 bonds to construct an elecrtic light plant here.

Wyo., Shoshone—The Wyoming Chemical Products Co., Duluth, Minn., plans to build a large plant for the manufacture of alum and epsom salts. A 750 hp. boiler, tanks, etc., will be installed in same. About $200,000. W. G. Wey, Engr.

Okla., El Reno—The City Clerk will soon award the contract for furnishing material and labor for improvements to water works system. Two 2,000,000 gal. per day steam pumping engine and a 1,000,000 gal. reservoir will be included in plans. Burns & McDonnell, Interstate Bldg., Kansas City, Mo., Engrs.

Okla., Madill—The City Comn. will receive bids until July 1 for a waterworks system including dam, reservoir, pumping station, elevated tank, water mains and supply lines for the city. About $410,000. Johnson & Benham, Engrs.

Cal., Bakersfield—The Southern California Edison Co., Edison Bldg., Los Angeles, has been granted authority to issue $1,985,000 bonds to complete the Kern River Plant 3, northwest of here, in connection with the proposed $5,000,000 hydro-electric development project.

Cal., Big Creek—The Southern California Edison Co., Edison Bldg., Los Angeles, has been granted authority to issue $2,108,000 bonds to construct third unit here and complete Shaver tunnel and reservoir, etc., in connection with the $5,000,000 hydro-electric development project.

Cal., Eagle Rock — The Southern California Edison Co., Edison Bldg., Los Angeles, has been granted authority to issue $312,000 bonds to increase the capacity of the substation here, in connection with the $5,000,000 hydro-electric development project.

Cal., Long Beach — The Southern California Edison Co., Edison Bldg, has been granted authority to issue $120,000 bonds to install a steam turbine at the station here, in connection with the $5,000,000 hydro-electric development project.

Cal., Los Angeles—The First Church of Los Angeles plans to build a 2 story, 100 x 200 ft. church including a steam heating system. About $1,000,000.

Cal., Sacramento—M. J. Desmond, City Clk., will receive bids about Aug. 15 for a pumping plant in connection with the proposed filtration plant. About $275,000. C. J. Hyde, Engr.

Cal., San Pedro—The Fabri-Cord Tire Co. has purchased a site on 17th St. and plans to construct a 3 story, 60 x 250 ft. tire factory including a boiler plant, etc., on same. About $2,000,000. S. H. Christian, 917 Citizens' Natl. Bank Bldg., Los Angeles, Pres.

Cal., Madera — The Madera Irrigation Dist. plans to build a distributing system to serve about 350,000 acres, pumping plants and drainage system, including a dam. Cost $15,000,000 to $20,000,000. Bonds will be voted upon for project. T. H. Means, 58 Sutter St., San Francisco, Chief Engr.

Cal., Richgrove—The Southern California Edison Co., Edison Bldg., Los Angeles, has been granted authority to issue $814,000 bonds to complete the substation here and $513,000 bonds to complete the transmission line from here to Kern River 3, in connection with the $5,000,000 hydro-electric development project.

Que., Montreal — The Protestant Bd. of School Comrs. received bids for installing heating, plumbing and ventilation systems in the proposed school to be known as the Devonshire School, from W. J. McGuire & Co., 332 Craig St., W., $63,500.

Que., Verdun—The city will receive bids until July 15 for an extension to the civic electric plant. About $38,000. A. Guyshon, Engr.

Ont., Hamilton—The city will soon receive bids for a steam auxiliary plant for the Hydro Electric System.

CONTRACTS AWARDED

Mass., Chelsea—The Commonwealth of Massachusetts, Boston, has awarded the contract for a 2 story, 35 x 90 ft. power house and laundry addition to the present building at the Soldiers' Home, here, to Joseph Slotnick, 448 B'way. About $125,000. Noted June 15.

Conn., Waterbury—The Waterbury Clock Co., 31 Cherry Ave., will build a 1 story, 50 x 57 ft. boiler house addition on Cherry Ave. About $20,000. Work will be done by day labor.

N. Y., New York—The City has awarded the contract for repairing the steam plant in the Hollenbeck Bldg., 505 Pearl St., to the Acme Furnace Co., 39 Cortlandt St., for $7,605.

N. Y., Brooklyn — The City Bureau of Charities, Municipal Bldg., New York City, has awarded the contract for repairs to boiler settings and new boiler fronts at the power house at the Kings County Hospital here, to the Acme Furnace Equipment Co., 39 Cortlandt St., at $15,052. Noted June 15.

N. J., Newark—The Bd. Educ., City Hall, has awarded the contract for the installation of a steam heating system in the proposed 3 story, 70 x 80 ft. school addition on Alexander St., to Fred P. Merhle, 533 Central St., at $35,972. Noted June 22.

N. C., Mooresville—The Mooresville Cotton Mills has awarded the contract for a steam plant and bleachery to the Flynt Bldg. & Constr. Co., 30 Church St., New York City. J. E. Sirrine, Engr.

O., Cincinnati—The United States Engineer's Office, War Dept., Wash., D. C., has awarded the contract for a wall power plant, etc., for dams 33 and 39 in the Ohio River. Lot "A" Turbines in dams 33 and 39 to the Trump Mfg. Co., Columbus Ave., Springfield, at $4,510; Lot "A" other things not given for dams 33 and 39, and Lot "B" valve jacks, to the J. and J. B. Millholland Co., 714 5th Ave., Pittsburgh, Pa., $11,699 and $17,155 respectively; Lot "C" pipe fittings, etc., dam 33 and Lot "C" pipe fittings dam 39, $6,236 and $7,748 respectively.

Mich., River Rouge—The Amer. Gypsum Co., Port Clinton, O., will build a material storage and handling plant and install electric driven elevating and conveying equipment for handling building materials, etc. About $75,000. Work will be done by day labor.

Wis., Hartford—The Kissel Motor Co. has awarded the contract for constructing and furnishing a 7 x 150 ft. stack and stokers to the Combustion Eng. Co., 11 B'way, New York City.

Wis., Milwaukee—The Bd. of Industrial Educ., Manufacturer's Home Bldg., has awarded the contract for furnishing power feeders, to the Jung Electric Service Co., Mason St., at $1,895.

Que., Montreal — The Montreal Light, Heat & Power Co., 83 Craig St., West, has awarded the contract for a 3 story, 29 x 47 ft. power house on Montana and Boyer Sts., to John Quinlan & Co., Green Ave., Westmount, at $22,000.

Que., Shawinigan Falls—The Belgo Canadian Pulp & Paper Co., Ltd., has awarded the contract for a transformer house and addition to grinder room and boiler house to William I. Bishop, Ltd., 622 New Birks Bldg., Montreal.

Volume 51 New York, June 29, 1920 *Number* 26

POWER

FRED R. LOW, *Editor*

BOILERS AND FURNACES

Correct Height of Return-Tubular Boiler Above the Grate 1031

BY HENRY MISOSTOW.

IN THIS ARTICLE THE AUTHOR claims that for best results with bituminous coal the shell of a return-tubular boiler should be set as near the fire as possible and still provide ample room for the gases.

EDITORIALS

1053, 1054

WILL WE HAVE TO COME TO THE BIG STICK AGAIN?—Electrical Interconnection—Electrically Driven Reversing Steel Mills—The Water-Power Bill Becomes a Law.

ELECTRICITY

Electrically Driven Steel Reversing Mills 1030

BY FRASER JEFFREY.

THIS ARTICLE DESCRIBES some of the features of an interesting installation in which a reversing motor and its necessary complements replaced an engine unit and enabled a material saving in cost of operation and maintenance.

Banding an Armature Without Removing It from Frame 1056

A Peculiar Meter Problem 1057

ELEVATORS

Electric-Elevator Machinery—Brake Adjustments 1038

BY M. A. MYERS.

ENUMERATES THE PRECAUTIONS to be observed in coupling motor to elevator machine and tells how to make brake adjustments properly and how to reline brake shoes and get the leather to make a good fit.

FUEL AND COMBUSTION

Care of CO_2 Recording Machines 1058

Naval Horsepower of 9,000,000 To Use Oil 1052

GAS AND OIL POWER

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ALLOY FOR METALLIC PACKING RINGS—Less Grate Area with Stokers Than with Hand Firing—Conversion of Baumé Degrees to Specific Gravity—Sloping Floor of Combustion Chamber—Designing Angle of Advance of Eccentric—Saving from Use of Feed-Water Heater—Setting Steam Valves of Duplex Pumps.

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POWER PLANTS

Interconnecting Industrial and Central-Station Plants 1049

IN THIS ARTICLE THE AUTHOR gives some indication of the large savings in coal, labor and transportation that would be possible from electrical interconnection on a give-and-take basis.

REFRIGERATION

Two Indirect Methods of Finding the Weight of Ammonia in Circulation in Compression Refrigeration 1042

BY J. W. GAVETT, JR.

OUTLINES TWO NON-MECHANICAL METHODS of computing the weight—the pressure-volume method and the temperature-entropy method. Little apparatus, beyond the plant proper, is needed in applying these methods.

Used Natural Refrigeration 1056

STEAM ENGINES

Case of a Stuck Governor Valve 1055

STEAM TURBINES

Another Long Run 1056

WATER POWER

Our Water Powers—Fallacies, Facts and Possibilities 1040

BY EARL STAFFORD.

GIVES A GENERAL IDEA of the limits and possibilities of water power and shows how the manufacturer owning a water-power plant may, with profit to himself, help to conserve the full resources of the country.

What a Definite Federal Water-Power Policy Will Mean 1061

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CIRCULATION OF THIS ISSUE, 30,400 COPIES

"I believe in the Business Journals"

—Edward N. Hurley

In this concise statement, Mr. Hurley, President of the Hurley Machine Company, Chicago, formerly Chairman of the U. S. Shipping Board, and prior to that Chairman of the Federal Trade Commission, summed up the part the business papers can play in facilitating the economic distribution of materials and manufactured goods from one industry to another, in his speech before the Associated Advertising Clubs of the World at Indianapolis.

Mr. Hurley said:

"When I was Chairman of the Federal Trade Commission, I made it a point to have the principal trade papers in the United States sent to me regularly. These were read not only by myself, but by the entire staff, so that we might have a finger on the pulse of the country's industry.

"Advertising agencies placing national and international advertising could well insist on every man in their employ reading the trade journals of the industries of their clients so that they may keep themselves currently informed on the conditions in the businesses for which they are writing copy.

"I believe in the business journals. I have been closely associated with the work of many and have made a study of them, and I am firmly convinced of the editorial strength and value of many of these publications."

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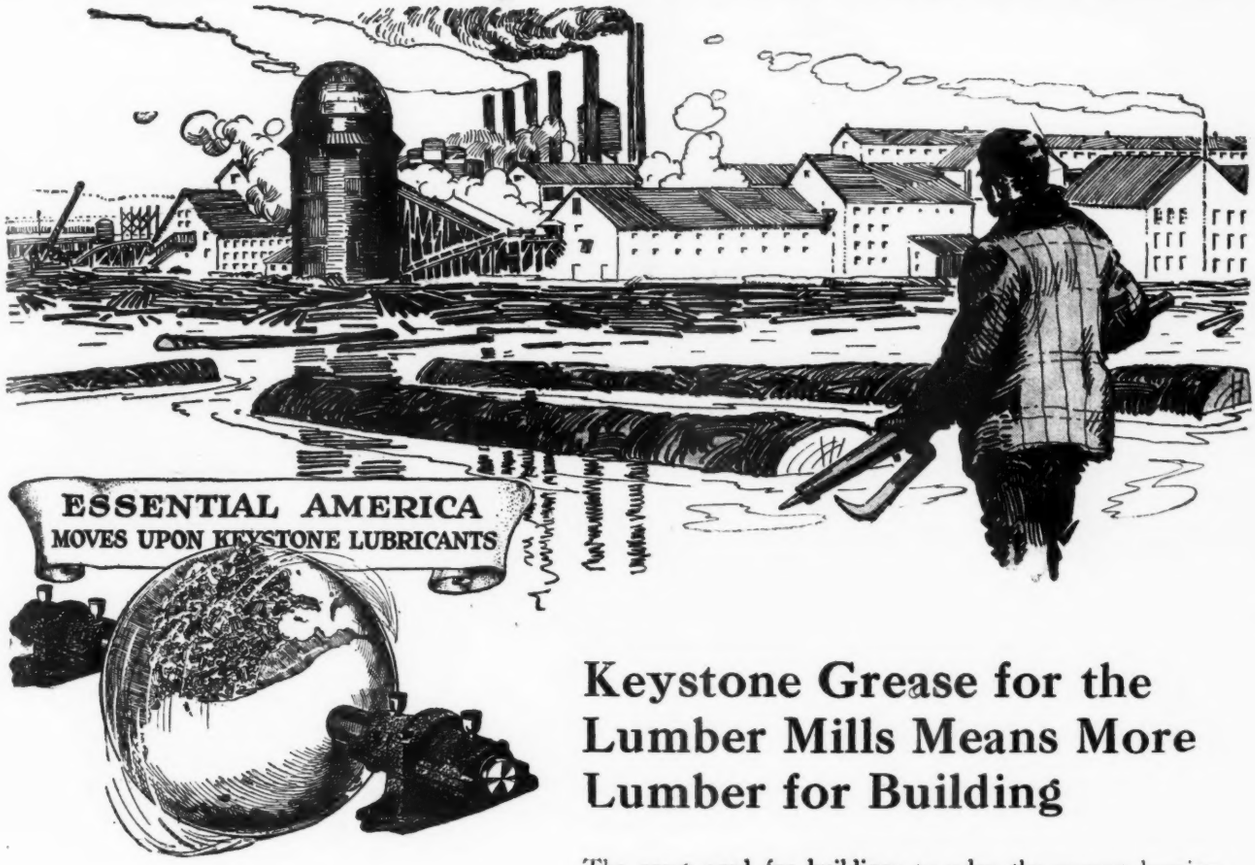
H-12

KEYSTONE LUBRICANTS



Keystone Grease for the Lumber Mills Means More Lumber for Building

The great need for buildings to solve the present housing problem means the production of lumber to the utmost.

Never before have such gigantic demands been made to the lumber industry—never before have lumber companies been more impressed with the value and efficiency of Keystone Grease.

Keystone Grease is remarkable for the conservation of time, labor and money. Keystone Grease is unaffected by speed or pressure—always "stays put"—cannot waste, sputter and collect dust—always remains the same consistency and keeps bearings properly filmed at all times. It saves the time of engineers and oilers—saves money—saves wear and tear on machinery—and eliminates shutdowns.

Let us explain our guarantee and arrange for a trial installation at our risk and expense.

KEYSTONE TRADE MARK Reg. U.S. Pat. Off. GREASE

KEYSTONE LUBRICATING CO.

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Boston
Pittsburgh
Chicago

India, Calcutta, Bombay
Norway, Christiania

Executive Office and Works
Philadelphia, Pa.
Established 1884

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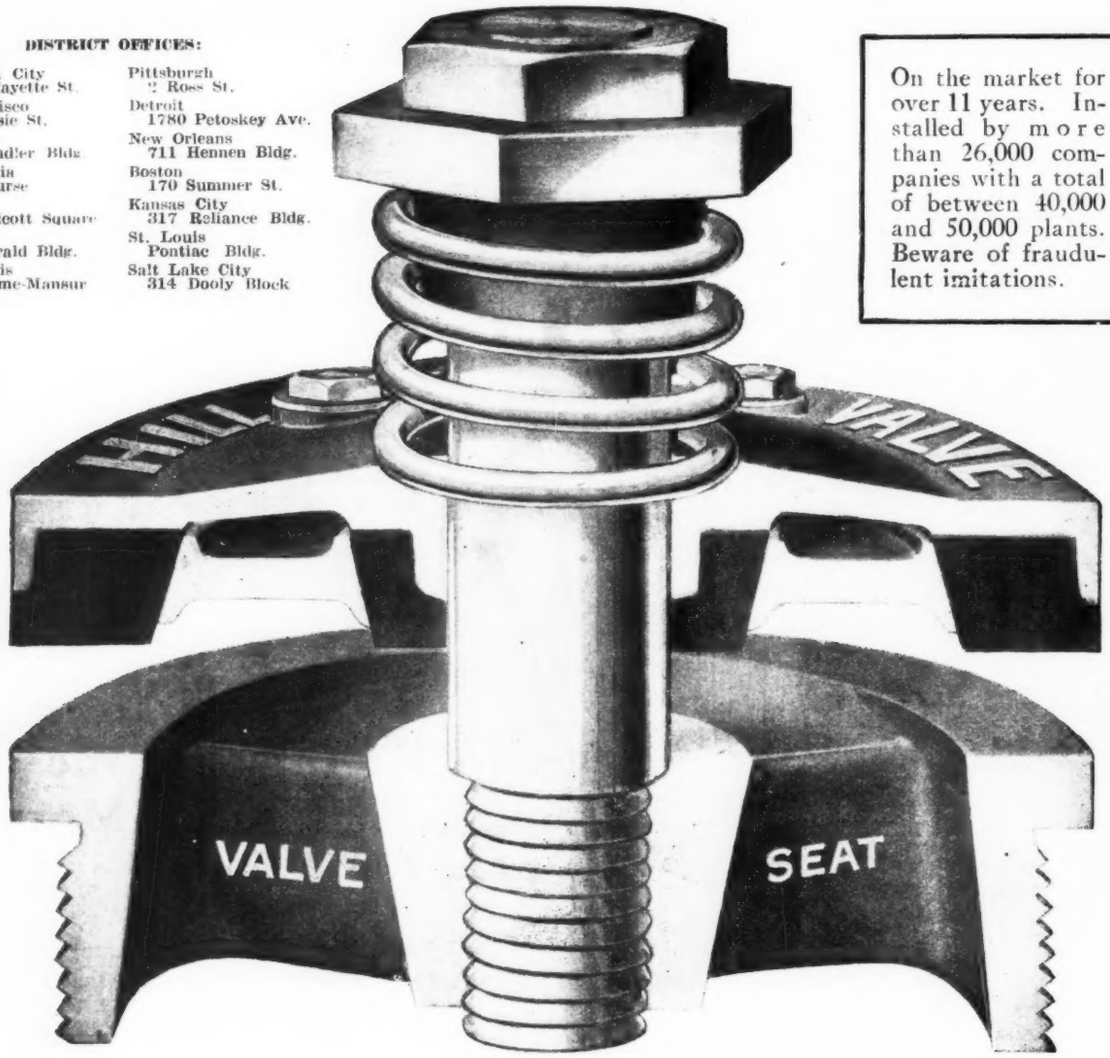
314 Dooly Block

On the market for over 11 years. Installed by more than 26,000 companies with a total of between 40,000 and 50,000 plants. Beware of fraudulent imitations.



You Can't Have Valve Trouble

If You Install

The HILL Pump Valve

The Hill Pump Valve is a sure means of escape from all valve trouble. It combines the many advantages of metal and rubber valves minus their faults and enables you to maintain your pumps permanently in economical operation without trouble and continual expense. Hill Pump Valves will lower your pump operation costs from 15% to 50%. No slippage—no frequent need of repairs—no renewals. Test these valves on your worst pump for 60 days at our expense. Read the coupon—clip it—mail it today.

The Hill Pump Valve Co.
Belmont and Knox Aves.,
Chicago

Clip This Coupon

Hill Pump Valve Co., Chicago, Ill.
We wish to take advantage of your offer to equip one of our pumps with Hill Pump Valves for 60 days free of charge.
The following facts are for your information. Sample Seat being sent via.....

No. of Valves	Temp. Water	Pressure	Name of Pump	Size of Pump	Pump No.

Seat is (pressed / threaded) and has..... threads per inch.
Face of seat is..... inches in diam.
Company.....
Engineer's Name.....
Full Address.....

Make Those Heat Blasts Count

YOUR boiler efficiency will not register 100 per cent unless the sheets and tubes are free from scale.

Dearborn Water Treatment, prepared to handle conditions in your plant, as shown by analysis of the water supply, will overcome scale formation, as well as corrosion and other injurious action, keeping the boilers in condition to yield full horse power constantly, and greatly reducing fuel consumption and repair expense.

Send in sample of your feed water taken after passing heater. Also description of your plant.

Dearborn Chemical Co.
General Offices, Laboratory and Works: Chicago
Eastern Offices: 299 Broadway, New York
Canadian Factory: 2454-2464 Dundas St., W. Toronto

DEARBORN

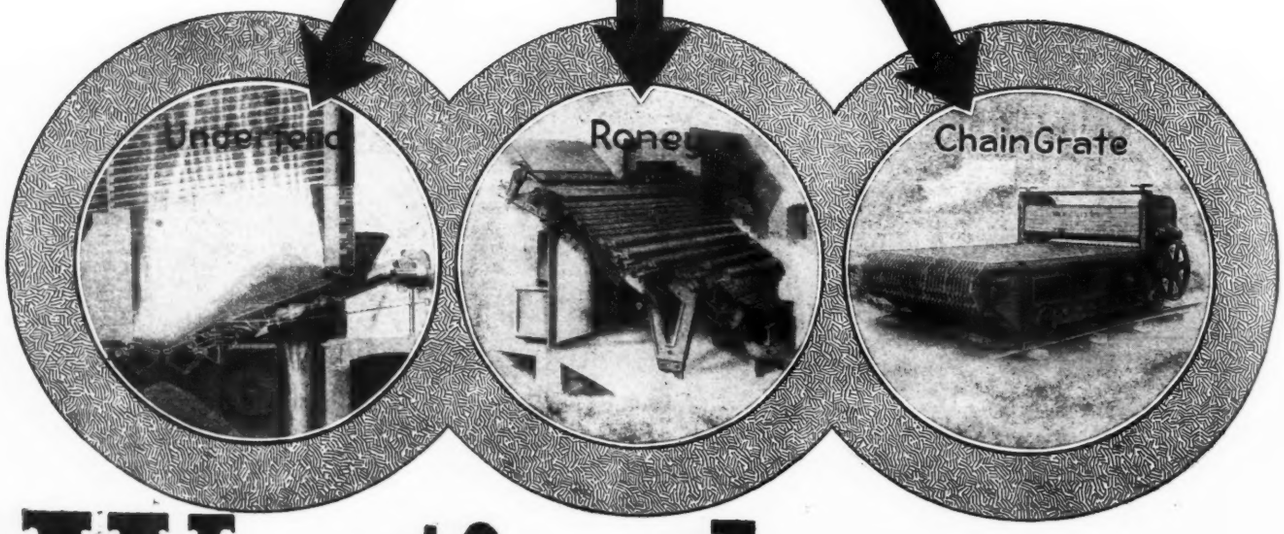
INDIVIDUALIZED Water Treatment

Lasting Satisfaction—

You will find it a permanent satisfaction to purchase your stoker from a manufacturer who can leave the choice of type largely to your own judgment.

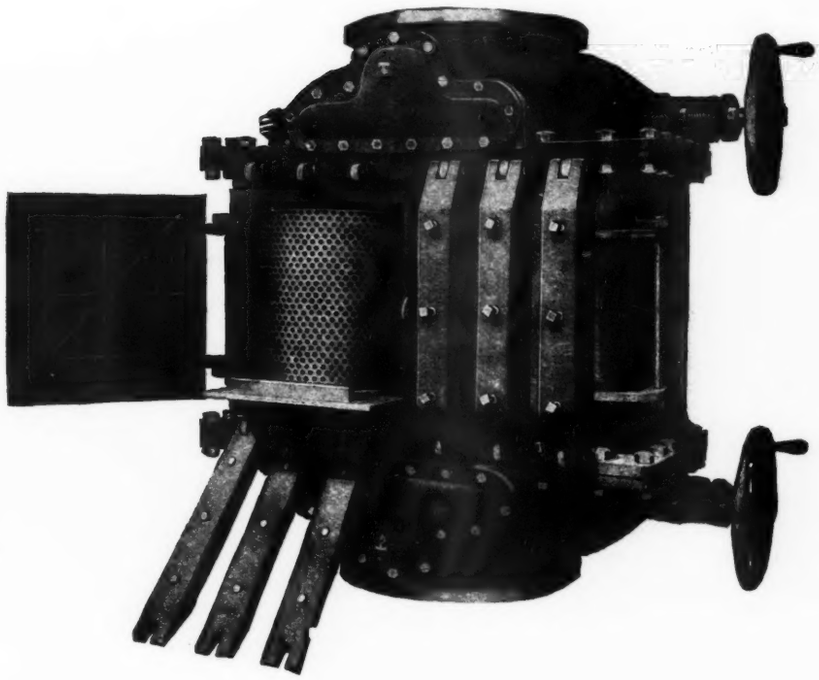
Let fuel, load and other local conditions be the determining factors.

WESTINGHOUSE ELECTRIC & MFG. COMPANY
East Pittsburgh, Penna.



Westinghouse

Underfeed, Overfeed and Chain Grate Stokers



Twin Strainers Save Money
Clean Water Without Expensive Upkeep

THE cost of an article is its purchase price plus the upkeep expense. If the bills for repairs and replacements amount to 15 or 20 per cent annually, it is only a few years until the expense of keeping apparatus in running condition amounts to as much as the installation cost, and the apparatus must be depreciated every year accordingly.

Continuous use over a period of several years without a cent for repair is only the usual record for a Twin Strainer installation.

We frequently have people write us enthusiastically about having had a Twin Strainer in use for eight or ten years with practically no upkeep expense.

When you are considering a Twin Strainer installation, ask some user about the Twin. Twin Strainer users are the best boosters we have.

Twin Strainers will handle water, oil or any other liquid, and can be installed anywhere —wherever it is most convenient. They are furnished in sizes from 1 in. to 42 in., inclusive. The mesh in the baskets is varied to suit the service.

Bulletin "A" gives full information and will be sent to anyone on request.

ELLIOTT PRODUCTS
Condensers
Air Ejectors
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Steam Separators
Receiver Separators
Blow-Off Valves
Oil Filters
Steam Traps

ELLIOTT COMPANY

448 *Fifth Avenue, Pittsburgh, Pa.*

Double Disc Taper Seat Construction in Iron Body Gate Valves

The result is a tight, dependable valve that gives extra long service, even under the hardest conditions. One reason is that the flexible seating mechanism adjusts itself to wear and the presence of slight accumulations on the seats.

Nelson Iron Body Gate Valves have this same distinctive double disc feature that appears in the widely used Nelson Steel Gates and Nelson Bronze Gates. There are two discs, bearing on a one-piece heavy central wedge, and traveling between *taper* seats in such a manner as to produce a flexible seating mechanism which closes with power like a toggle.

Nelson Iron Body Gate Valves are built in all the regular types, outside and inside screw, for standard, medium and extra heavy pressures. They are backed up by a line of iron body globes, angles and checks, non-return valves, steel and bronze valves which make it possible to equip a plant "Nelson throughout."

Every valve user should have our catalog. It's a hand book of valve information. We'll send it. Your name and address on a post card will do.

NELSON VALVE COMPANY

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Boston, 141 Milk Street
Detroit, 816 Ford Bldg.
San Francisco, Hearst Bldg.
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NELSON VALVES

There's A Big Difference Between Well-Done and Half-Done

ESPECIALLY when it comes to removing the scale from a boiler's tubes, where the difference between "well-done" and "half-done" is perhaps a large slice of the boiler's normal efficiency.

Scale in a boiler is costly. Every engineer knows that only too well. But there is no reason why a good tube cleaner should not "get" all the scale. VICTOR—the speedy little Liberty Cleaner—will do it. Ever see a VICTOR in action? Well, you'd be surprised!

The "VICTOR" Tube Cleaner operates on either air or steam. For use on 3½-in. and 4-in. straight tubes or for curved tubes in smaller sizes. Fully described in Catalog Z, a copy of which will be sent you by return mail if you ask for it.

Liberty Manufacturing Company
435 Grant St.
Pittsburgh, Pa.

Perfected Steam Turbine Lubrication

Severe service, rapid circulation, and moisture—conditions common to all steam tpurbines—will in time cause the best oil to emulsify, oxidize and break down with the formation of sludge and a low degree of acidity.

The R-P Steam Turbine Continuous By-Pass Oil Filtration system removes as fast as formed all dirt, grit, sludge and oxidation products, maintaining the oil in its original pure state, indefinitely—literally for years.

This system saves **oil,** eliminates high bearing temperatures caused by dirty oil, assures proper governor regulation, and decreases the cost of operation by making unnecessary frequent cleaning of the oiling system, replacement of the oil, or shutdowns caused by impurities in the oil.

Send for a copy of the new R-P Book on Steam Turbine Continuous By-Pass Oil Filtering Systems. It is full of good lubrication data—new developments not found in text books. It is free. Write for your copy now.

THE RICHARDSON-PHENIX CO.

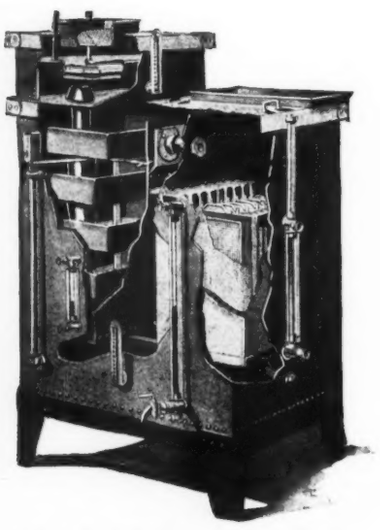
LUBRICATION ENGINEERS AND MANUFACTURERS

WORKS-124 RESERVOIR AVE. MILWAUKEE, WIS.

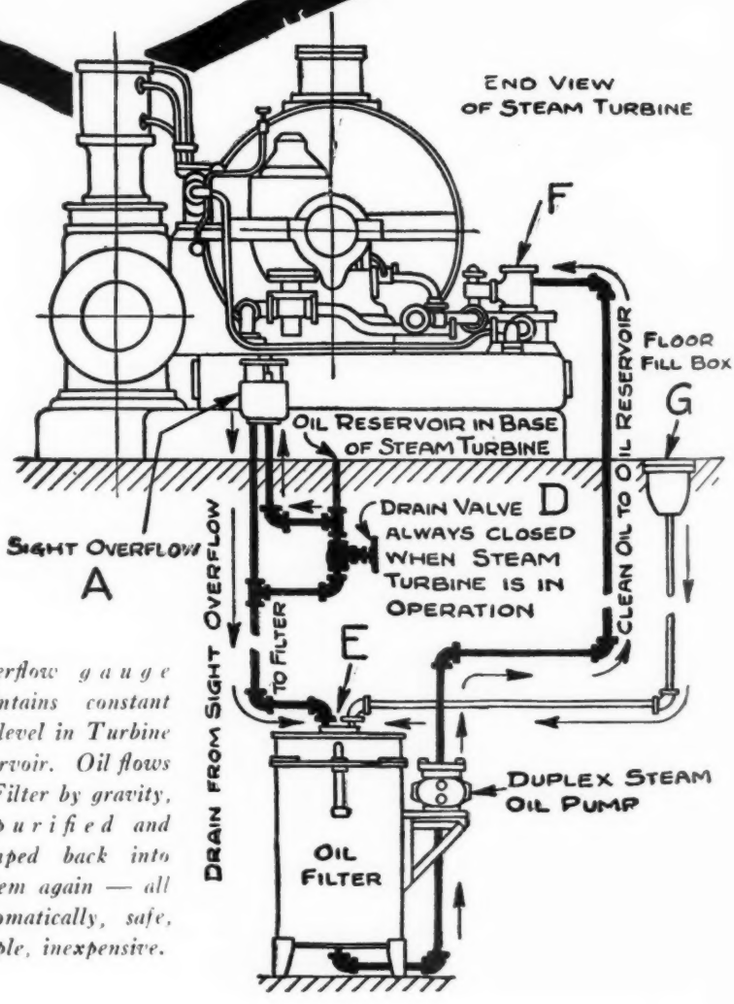
R P

OIL FILTERS

SCIENTIFIC LUBRICATION



No. 5 R-P Type "AS" Filter. Capacity 100-200 gallons per hour.



Overflow gauge maintains constant oil level in Turbine reservoir. Oil flows to Filter by gravity, is purified and pumped back into system again — all automatically, safe, simple, inexpensive.

Proper Flow of Water— No Loss of Efficiency

The illustrations below show the action of the ordinary pump valve. The flow of the liquid through the valve is deflected at right angles to the disc.

In the NoKut Pump Valve the ports are straight, the metal to metal seats beveled. Water passes through the valve but slightly deflected, flow is practically parallel to the valve chamber.

Friction is reduced to the minimum; eddies are eliminated as the water in passing through one valve does not meet the water from the next. Thus the valve has but a very low lift and closes promptly with practically no slippage. Two flexible composition sealing rings forced against the seats by the pressure when the valve closes absolutely prevent leakage.

The new R-P NoKut Pump Valve Book describes in detail the design of this remarkable valve—its metal to metal seats; the flexible composition sealing rings that absolutely prevent leakage; its sturdy construction and extremely long life. This book is free. Write for your copy now.

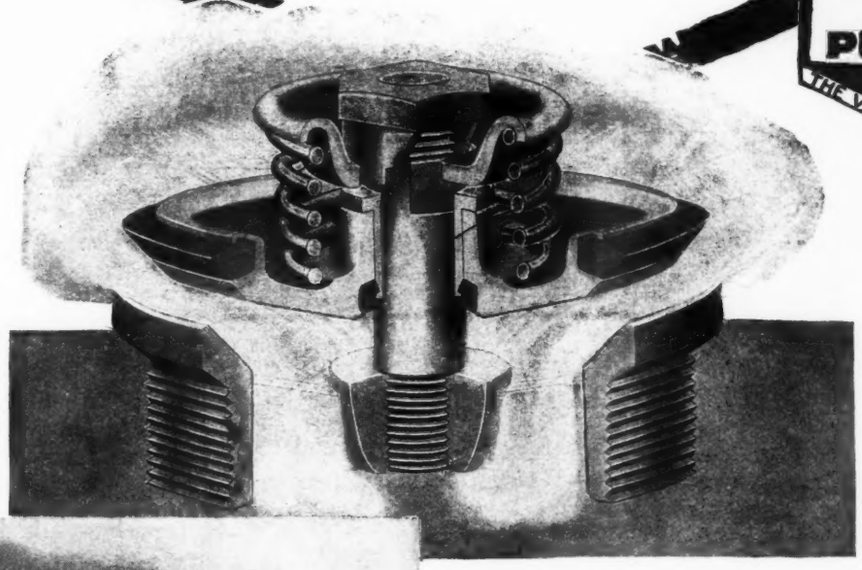
THE RICHARDSON-PHENIX CO.

MANUFACTURERS OF HIGH GRADE VALVES

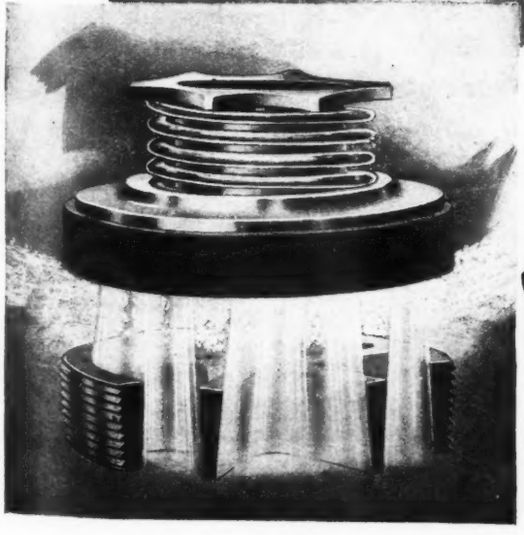
WORKS 124 RESERVOIR AVE., MILWAUKEE, WIS. U.S.A.

R NoKut PUMP VALVES P

THE VALVE WITH THE PROTECTED SEAT

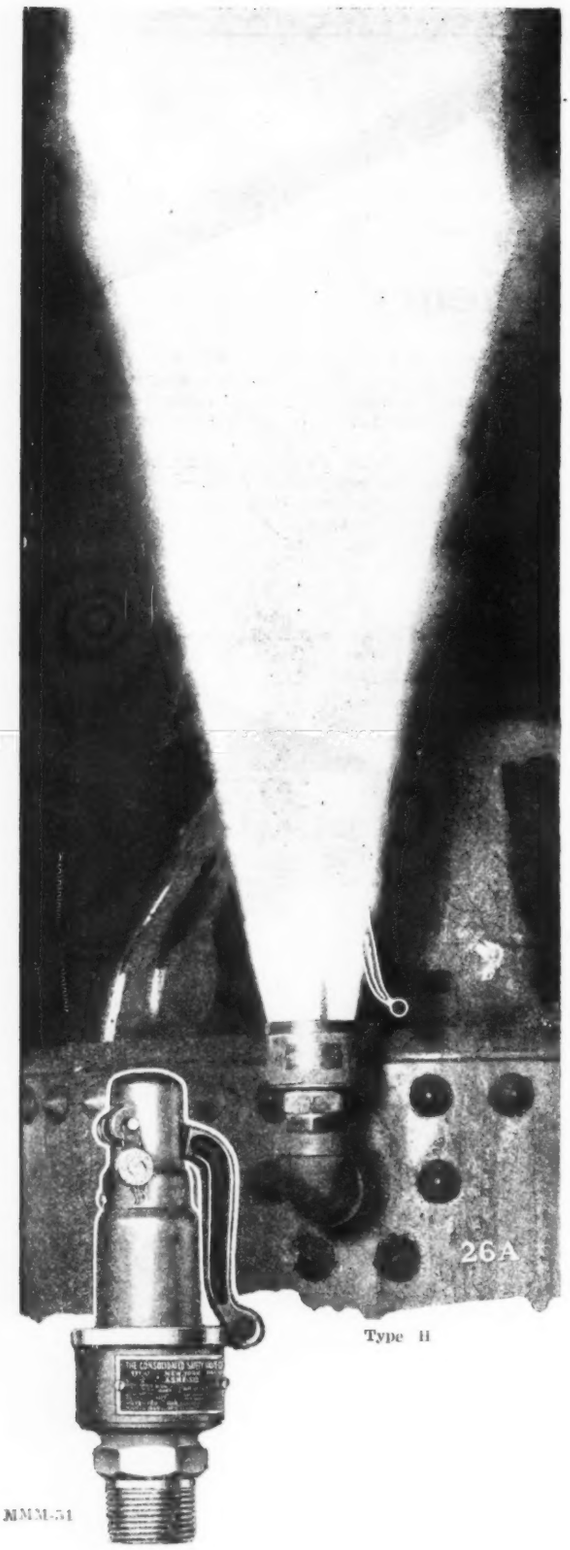


Correct Flow of Water



The two illustrations on this page show conclusively the big advantages the NoKut Pump Valve has over the ordinary type. Note carefully the flow—correct in the NoKut, incorrect in other types; metal to metal seats; flexible composition sealing rings absolutely prevent leakage. Can be taken apart without the use of a single tool, and without removing the valve body.

Incorrect Flow of Water



Type H

MMM-51

"Consolidated"—

is the best insurance for small and portable boilers

You don't need an introduction to Consolidated Safety Valves for large boilers. They're standard equipment on boilers everywhere from Maine to Texas—many places they've been in 15 to 20 years.

So many engineers wanted a smaller Consolidated for small and portable boilers that about a year ago we brought out the type shown here. It's made of brass with that nice skin finish.

This small type has all the features that made the big Consolidated Valves so popular. It blows instantly at the popping pressure and has a big excess-relieving capacity that absolutely prevents overpressure. Just look at that photo at the left!

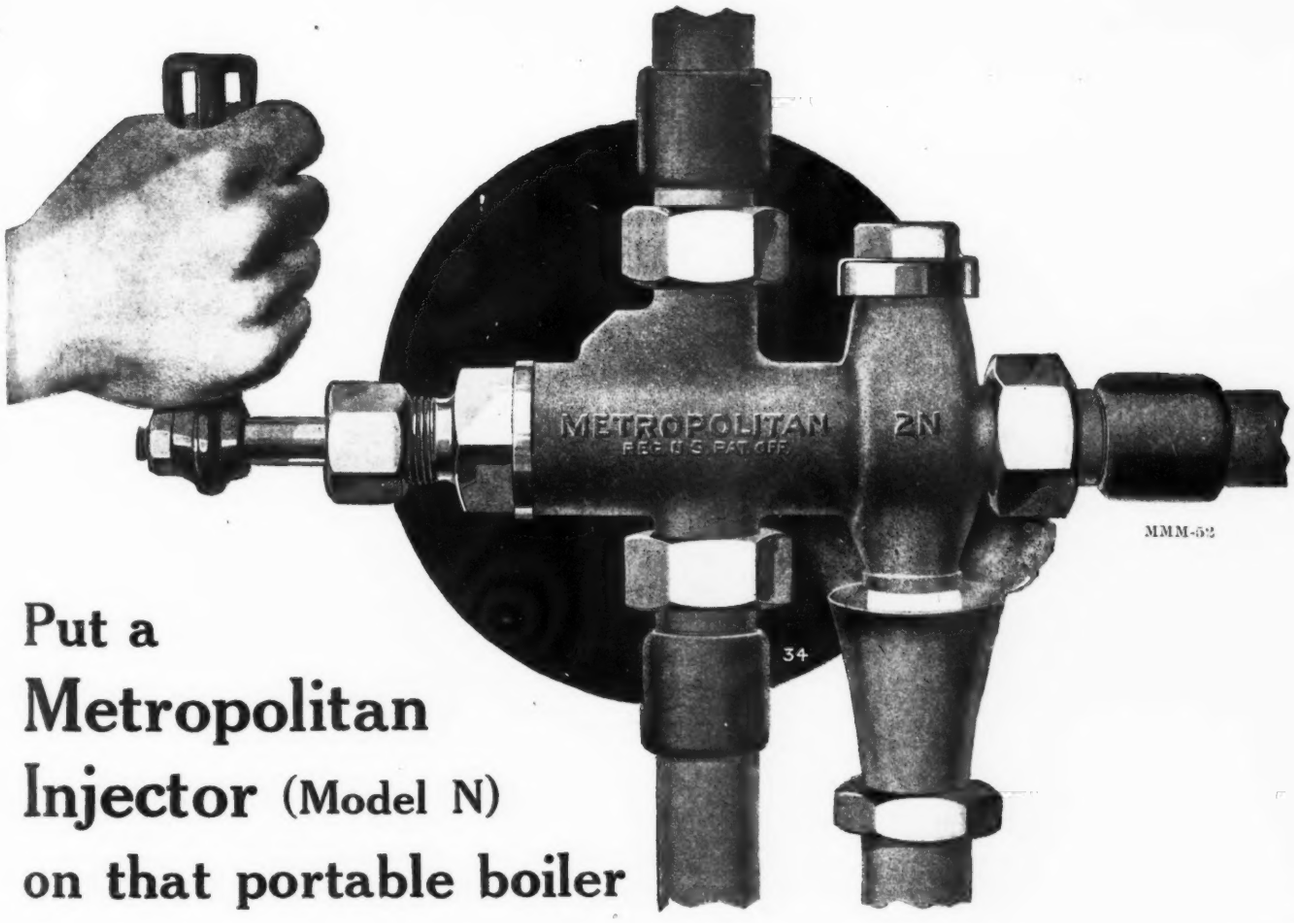
"Consolidated" Safety Valves are made with side outlet (Form I) and muffler (Form K) besides the type shown (Form H), in sizes from ½ to 3-in. and set at 100 and 125 pounds.

Your jobber stocks them and the plate on each valve gives all the information necessary for you to select just the right size.

CONSOLIDATED SAFETY VALVE CO.,
SALES DEPARTMENT OF
MANNING, MAXWELL AND MOORE, INC.

119 West 40TH St. NEW YORK — 29 North Jefferson St., CHICAGO

Consolidated Safety Valves, Hancock Inspirator, Hancock Valves, Metropolitan Injectors



Put a Metropolitan Injector (Model N) on that portable boiler

There are lots of advantages in having your portable boiler equipped with a Metropolitan Injector (Model N).

First, it's so easy to operate: a turn of the handle starts or stops it. You can let your fireman attend to it and be sure he'll feed the boiler right.

Then it will lift water 20 feet, without any adjustment, and will take it as hot as 120°. And if the water supply is interrupted, the Metropolitan just picks up again, and goes right on feeding the boiler, without any attention.

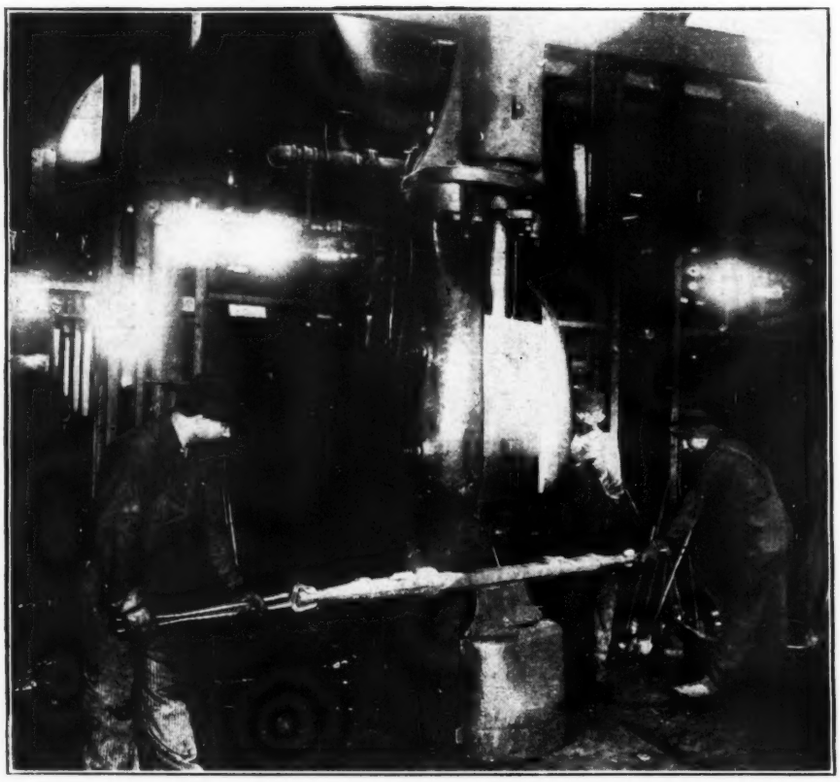
You can inject water with 20 pounds of steam if you need to, without adjusting the Metropolitan at all. It'll keep right on working as the pressure rises.

Metropolitan Injectors (Model N) are made of the best metals we can get, and as carefully as 26 years have shown us how. They'll seldom need repair or replacements. But if it become necessary to make them, or to clean out the injector—you can take the Metropolitan Injector (Model N) apart with a monkey wrench.

Your jobber stocks these injectors and has the right size for your boiler. And we'll send you our injector book if you want it.

The HAYDEN & DERBY MFG. CO.,
SALES DEPARTMENT OF
MANNING, MAXWELL AND MOORE, INC.
119 West 40th St. NEW YORK 29 North Jefferson St., CHICAGO
Consolidated Safety Valves, Hancock Inspirators, Hancock Valves, Metropolitan Injectors

EASE OF



Economy
Capacity
Simplicity
Ease of Operation✓
Ease of Installation

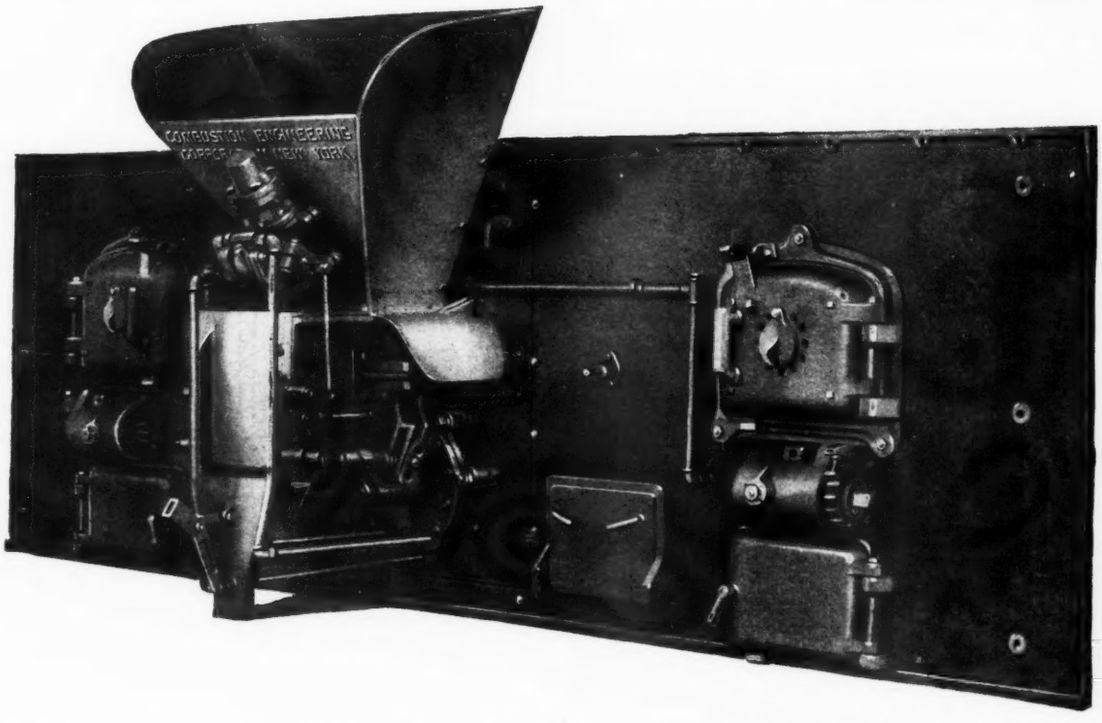
It's easier on the man who's operating it than swinging a sledge. There's more force in its blows than many men could give.

It's the modern way—

FOPERATION
TYPE E STOKERS

STANDARD WHEREVER COAL IS BURNED

for high duty furnaces. Easier on the men than swinging a shovel. There is more power developed from low grade fuel with fewer men. They are the modern way of firing big boilers.



Combustion Engineering Corporation

11 Broadway, New York City

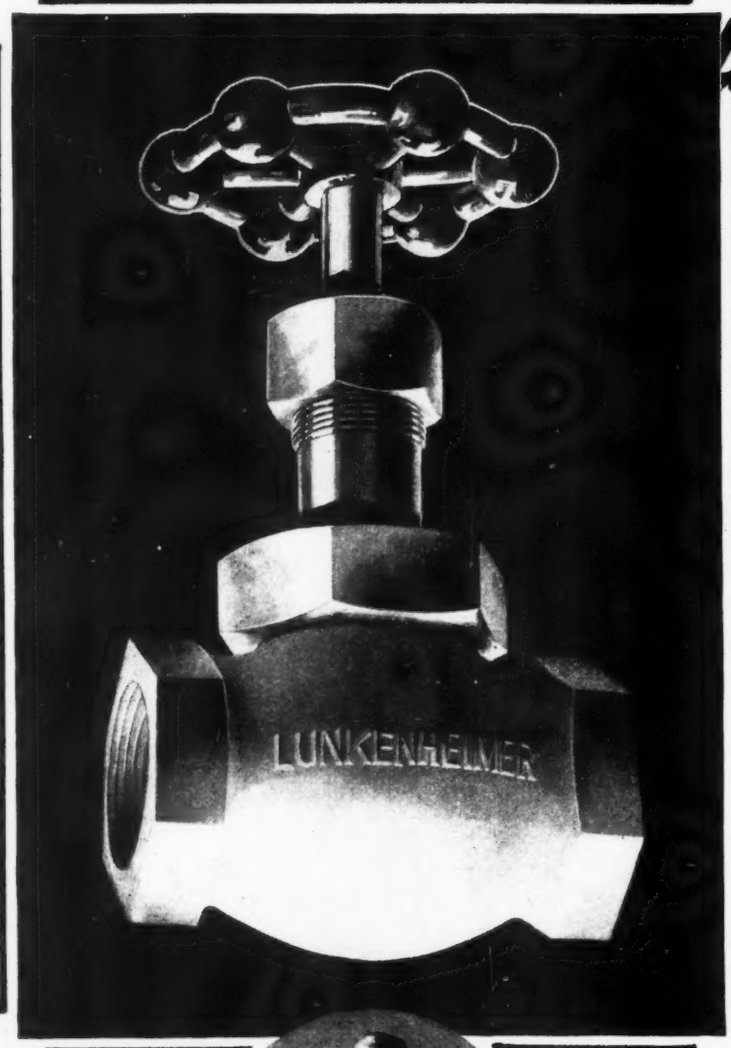
Owners and Manufacturers of

Type E Stokers—for Bituminous Coal — The Grieve Grate—Hand-Firing

Coxe Stokers—Anthracite Coal and Coke Breeze

PHILADELPHIA, PA. ALBANY, N. Y. BOSTON, MASS. MILWAUKEE, WIS. MINNEAPOLIS, MINN.
HAZLETON, PA. PITTSBURGH, PA. DETROIT, MICH. BIRMINGHAM, ALA. CHICAGO, ILL.
OMAHA, NEB. DENVER, COLO. SALT LAKE CITY, UTAH
TAYLOR ENGINEERING CO., VANCOUVER, B. C.

Superiority—unfailing



AMERICA'S BEST
LUNKENHEIMER
QUALITY
SINCE 1862

The original Regrinding Valve

performance —service

LUNKENHEIMER REGRINDING VALVES

have firmly established their unparalleled merit by the successful results they have given through many years of satisfactory service.

The metal to metal seat—ground to a tight fit—forms the ideal seating surface to resist the wearing action of steam at high velocity. And the fact that the seating surfaces can be reground (an inexpensive operation easily accomplished) makes the renewal of parts wholly unnecessary.

Their extreme durability—due to correctly proportioned parts, high quality materials and expert workmanship—insures economy in maintenance.

Globe, Angle and Cross Valves with Inside Screw and with Outside Screw and Yoke; and Horizontal, Angle, Vertical and Swing Check Valves for 200 and 300 Pounds working steam pressure.

Specify Lunkenheimer and insist on their installation. Distributors of Lunkenheimer Products situated in every commercial center.

Write for descriptive Booklet No. 517-DB.

THE LUNKENHEIMER CO.
"QUALITY"

Largest Manufacturers of High Grade Engineering Specialties in the World

CINCINNATI

New York Chicago Boston London

3-21-42

Q

CHAPMAN

VALVES

¼ inch to 9 feet

Just a glimpse of a corner of the CHAPMAN ASSEMBLY DEPT. where Chapman valves from ¼ inch to 9 feet in diameter are tested and shipped to all parts of the world.

As the oldest and largest manufacturers of Gate and Check Valves and Sluice Gates we have justly earned the title of Valve Headquarters.

We maintain a corps of engineering experts trained in solving valve problems—

They will gladly study your proposition—make recommendations and show you how to get maximum valve service with minimum cost. Will make special design to fit any particular requirements.

When in doubt consult the Chapman experts at Valve Headquarters

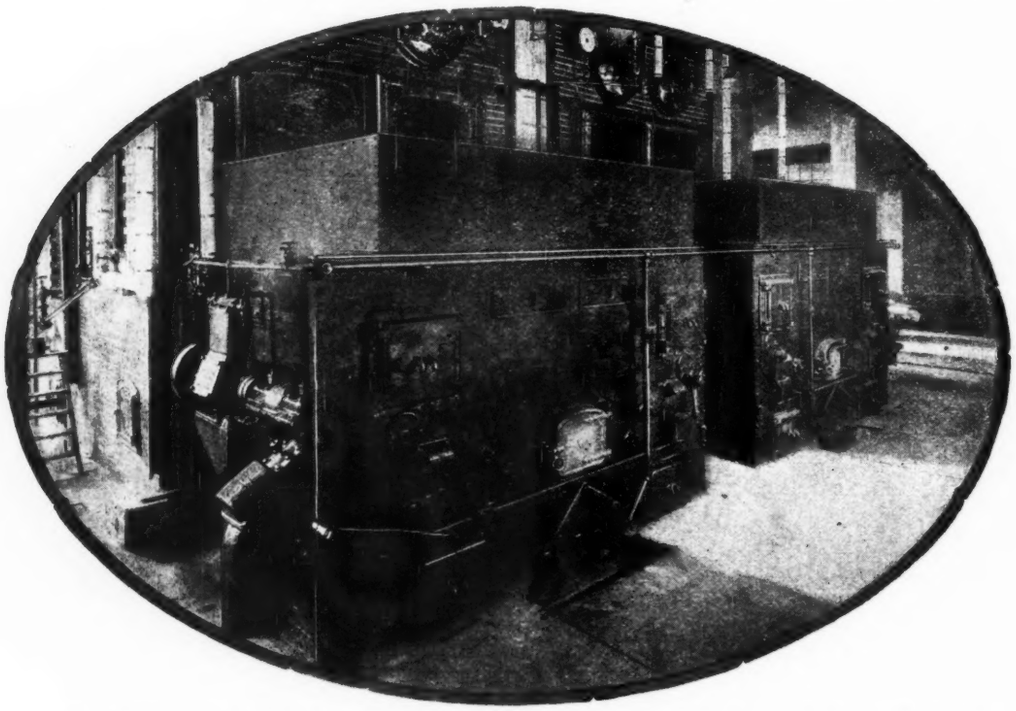
The Chapman Valve Manufacturing Co.

Indian Orchard, Mass.

Branch Offices and Agents with Stock in Principal Cities

Back for More

After 20 years of Operation



In 1897 the National Lead Company of Cincinnati installed two Murphy Automatic Furnaces under two 250 horsepower B. & W. boilers. These stokers were so successful in their operation that when the National Lead Company remodeled its plant twenty years later they naturally chose the same dependable equipment:

MURPHY
AUTOMATIC
FURNACES

The one thing that every Murphy user likes best about his equipment is its dependability.

The Murphy Furnace is heavily built and well protected—this means low maintenance. The design and construction is as nearly fool proof as forty years of stoker experience can make it. The Murphy Furnace is highly automatic in its operation and requires very little attention. The coal is fed—the fuel distributed—the fire cleaned—the ash and refuse continuously and automatically removed.

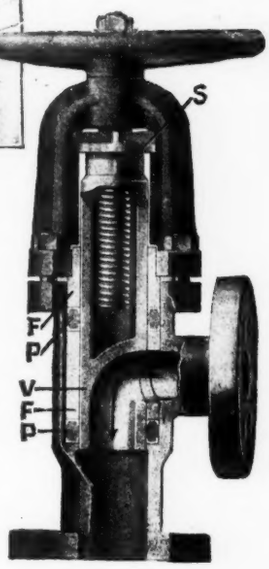
If you are interested in stokers that *burn anything that has heat in it*—stokers that last a life time—stokers that you will order again twenty or thirty years from now, then you should install the Murphy.

Your plant may offer large opportunities for saving. Let our Service Engineers investigate. Remember it is the forty years of stoker experience that place the right equipment in your plant.

Send for Catalog P-6

MURPHY IRON WORKS, Detroit, Michigan

BURN ANY FUEL THAT HAS HEAT IN IT



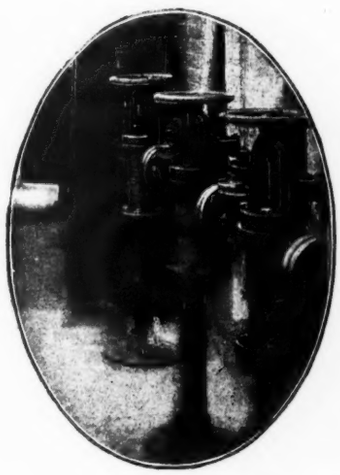
In Massachusetts—

IN the United Electric Light Company's plant at Springfield, thirty-six **Yarway Seatless Blow-Off Valves** have been in continuous service since October 1, 1916.

The simple and durable construction of these valves guarantees faithful service and long life.

In operating, shoulder S on plunger V engages the follower gland F, compressing packing P above and below the port, and making an absolutely tight valve.

Full details and list of well-known users on request.



YARNALL-WARING COMPANY

Mermaid Avenue

Chestnut Hill **Philadelphia**

BOSTON	NEW YORK	CLEVELAND	MINNEAPOLIS
DENVER	ST. LOUIS	MONTREAL	NEW ORLEANS
CHICAGO	SYRACUSE	RICHMOND	INDIANAPOLIS
EL PASO	DALLAS	CINCINNATI	PITTSBURGH
	ATLANTA	DETROIT	SAN FRANCISCO

"No Seat to Leak"

JOSEPH HARRINGTON SAYS:

Joseph Harrington, formerly administrative engineer for the State of Illinois

"These demands are usually unexpected and the water tender does not know that the rate has increased until he finds the water low in the glass."

With dropping steam pressure and a strong feed it is next to impossible for the fireman to build up the pressure quickly. In his attempts to do so, he is more than likely to overload the furnace, produce smoke and injure the brickwork.

A shutting off of the boiler feed will serve to boost the boiler output for a little while to extreme limits.

When there is a sudden letdown of the load, feeding heavily for a little while will save much good heat that would otherwise be wasted by popping safety valves or escaping gases up the stack.

A reliable feed-water regulator accomplishing this effect is both an insurance and an element of economy.

COPES
Boiler Feed Regulators

They have proved their complete reliability in automatic feed regulation and their economy by saving from 1 to over 3 per cent. in fuel. They invariably pay for themselves several times a year.

The design is so simple and the operation so positive, that there is no danger of breakdown or trouble after the regulators have been cut into service.

Over nine million boiler horsepower in the United States are Copes operated.

Our engineers have valuable data on feed regulation. Let them present it to you and point out how Copes Boiler Feed Regulators would insure better boiler economy.

Write for Bulletin "A"

NORTHERN EQUIPMENT CO.

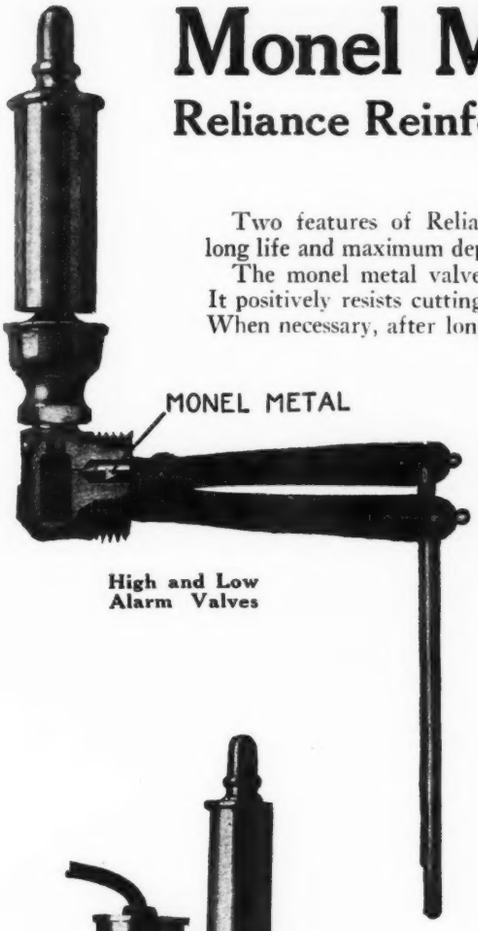
110 WEST 11TH STREET.——.——.ERIE, PENN.

The World's largest manufacturers of Feed Water Regulators.

Monel Metal Valves

Reliance Reinforced

Seamless Floats



High and Low Alarm Valves

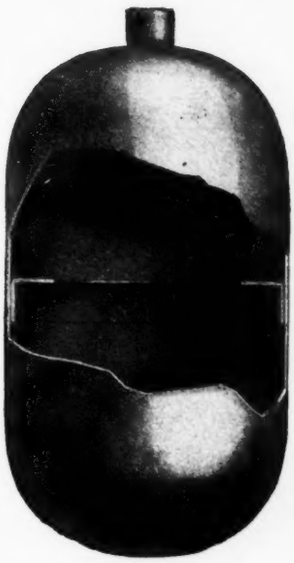
Two features of Reliance Safety Water Columns that mean long life and maximum dependability under hard service conditions.

The monel metal valve is accurately machined to seat tightly. It positively resists cutting action and does not require regrinding. When necessary, after long service, both the valve and the government bronze valve body may be renewed. Theentire valve machanism is located near the top of the water column, far removed from the scale and sediment.

The Reliance Seamless Floats employed are strongly reinforced and are entirely capable of withstanding the highest operating pressures. They are made by a special process and subjected to rigid tests for tightness, buoyancy and strength before installing them in the columns.

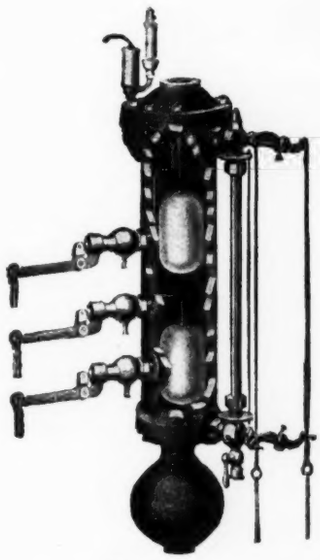
A patented Electric Alarm may be attached to give warning of improper water levels at distant points by lighting lamps, sounding buzzers or recording water levels on charts.

You owe it to the safety of your plant to install only thoroughly tried and proven water columns on your boilers. Specify "Reliance" and be sure.



Reinforced Seamless Floats

Electric Alarm Patented



Reliance Safety Water Columns

Reliance Steam Specialties

ARE ALL FACTORY TESTED

Safety Water Columns
Electric Water Alarms
Quick Closing Water Gauges
Lever Gauge Cocks
Seamless Floats
Steam Traps

Write for information ***Specify RELIANCE***

THE RELIANCE GAUGE COLUMN COMPANY

5924 Carnegie Ave., Cleveland, Ohio

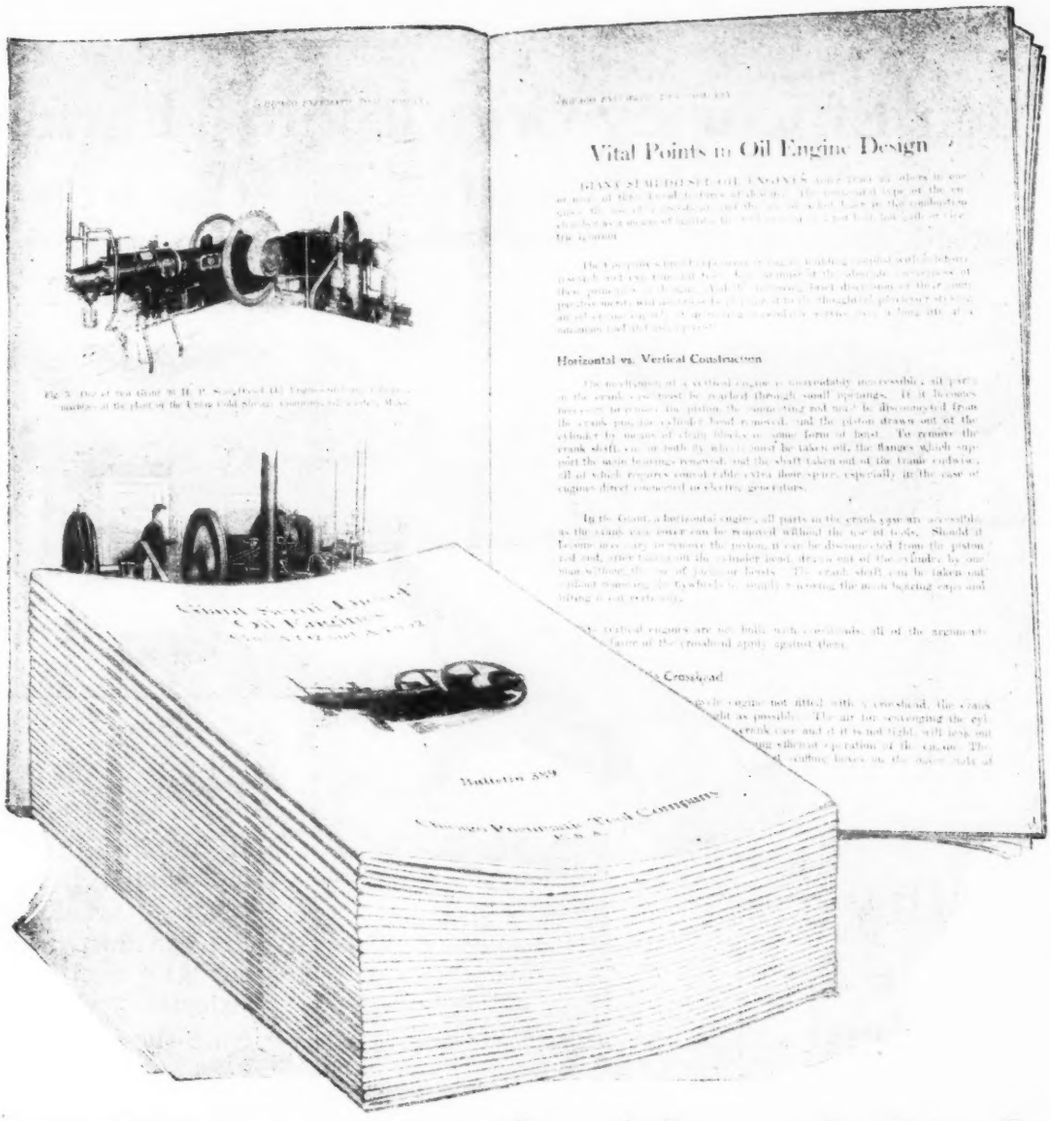
A Heat Conductor

Perolin—Boiler Metal Treatment—removes boiler scale by mechanical expansion.

It prevents new scale from forming by the establishment of a thin, amalgam film on the boiler metal, which repels all scale forming salts. This film also protects the boiler metal against pitting and corrosion and is an excellent *heat conductor*.

The Perolin Company of America

New York Chicago Toronto London



Every power user should read this book

The low cost of fuel oil for power, **coupled with the time-proven dependability of the Giant Oil Engine is enabling power users everywhere to adopt oil as their standard fuel, and Giant Oil Engines their standard prime movers for operation on it. The book, "Giant Semi-Diesel Oil Engines" is an instructive publication from which every power user can glean many facts about oil engine design, construction and operation—facts that point the way to better, more economical power. Request your copy through the Company Branch nearest you.**

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EN-38

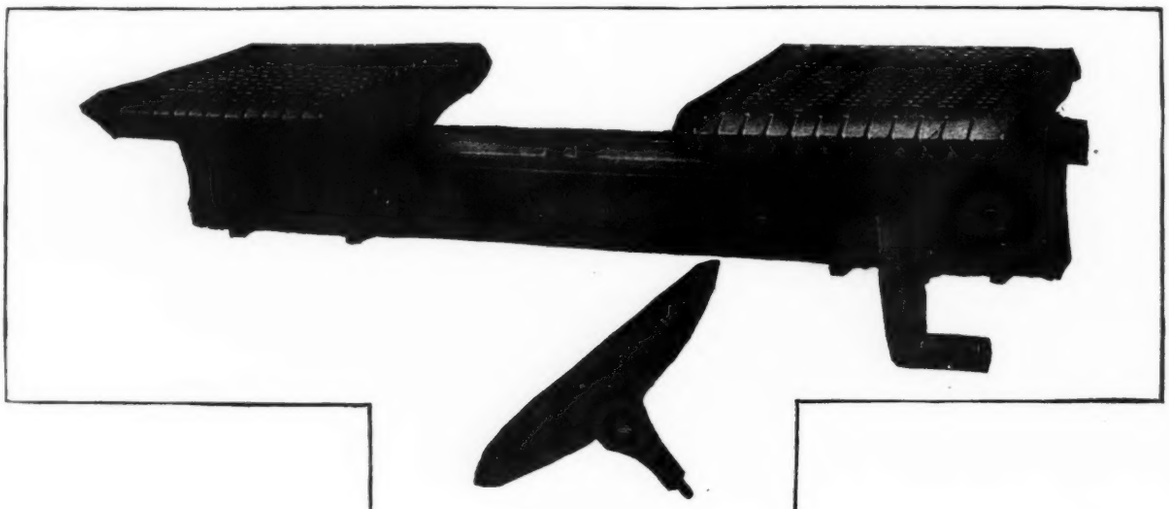
BOYER PNEUMATIC HAMMERS··LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS··VACUUM PUMPS··PNEUMATIC HOISTS,
GIANT OIL AND GAS ENGINES ROCK DRILLS·· COAL DRILLS

GIANT ENGINES

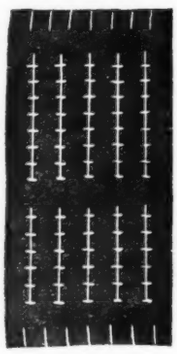
Dependable Power at Less Cost Per Hour

When Efficiency Crawls into a Furnace

Perfect combustion occurs. The cheapest coal is converted into steam. Waste ceases—economy begins.



McClave Grate 4-A Is Efficient

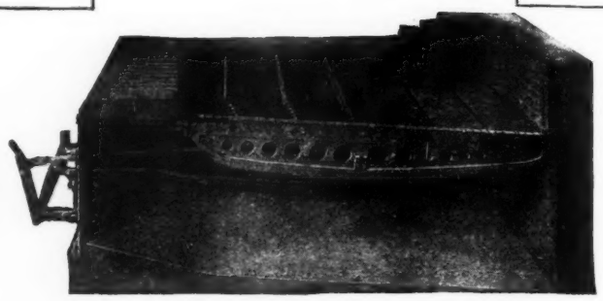


It retains the finest fuel—and rejects only ash.

Forced draft will not cut the fuel bed to strips.

Note the beveled edge bars and removable tops.

Isn't this the kind of efficiency you demand?



McClave Grate No. 4-A installed complete. Illustration shows divided cut-off position.

Write for Catalog "G." This gives a full account of all the McClave lines and the Argand Blower.

McCLAVE-BROOKS COMPANY

Main Office and Works, Scranton, Pa.

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S. C. Smith, Mgr.

Philadelphia Office
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George Blair, Jr., Mgr.

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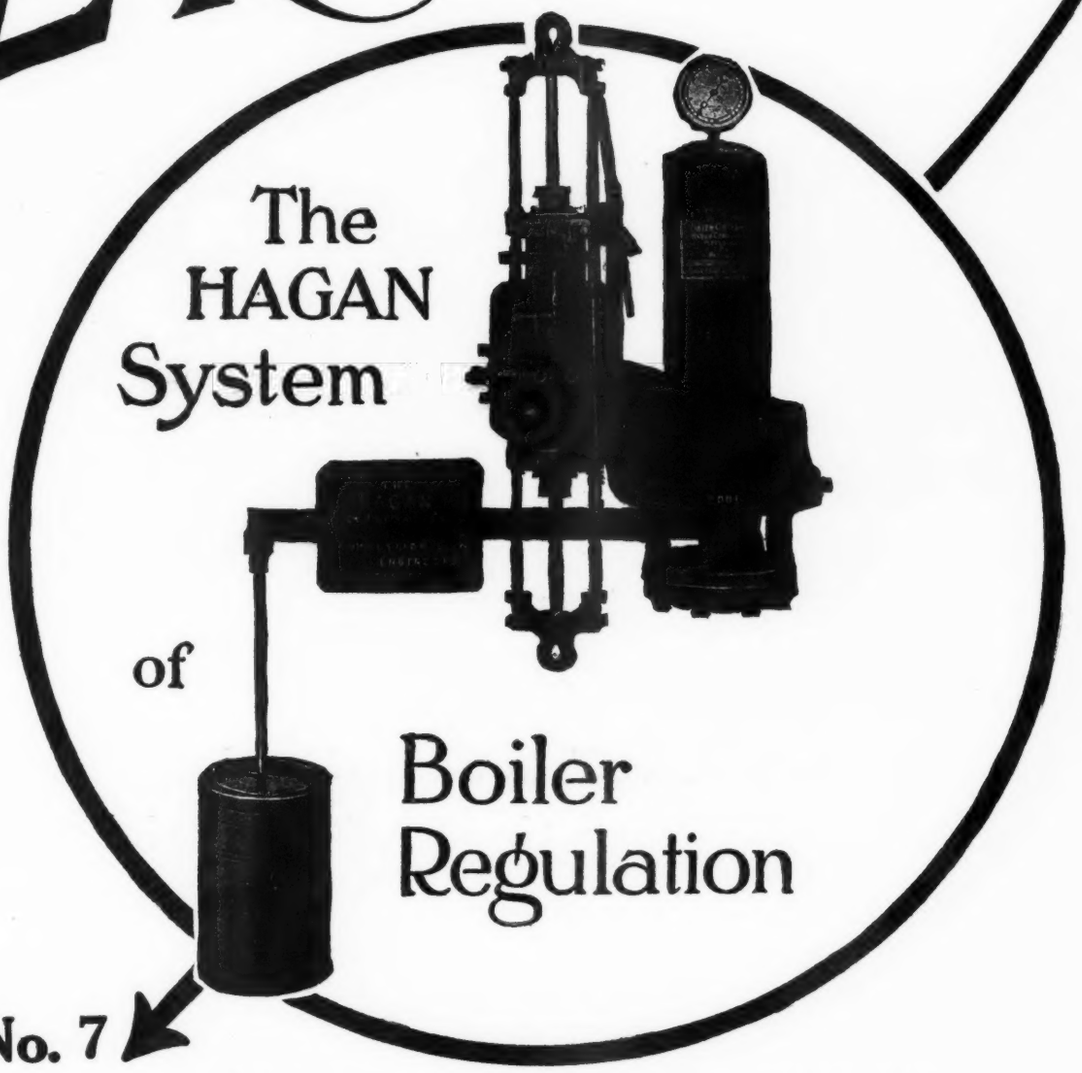
New Orleans
951 North Carrollton Ave.
D. W. Robertson, Rep.

12 Reasons Why



SMOKE ELIMINATION

"We have not had a smoke violation since we installed your Regulating Apparatus."

We are told this right along—but we sell you HAGAN REGULATION primarily to SAVE COAL. The many other benefits that follow in the wake of PROPER REGULATION, are valuable, but incidental.

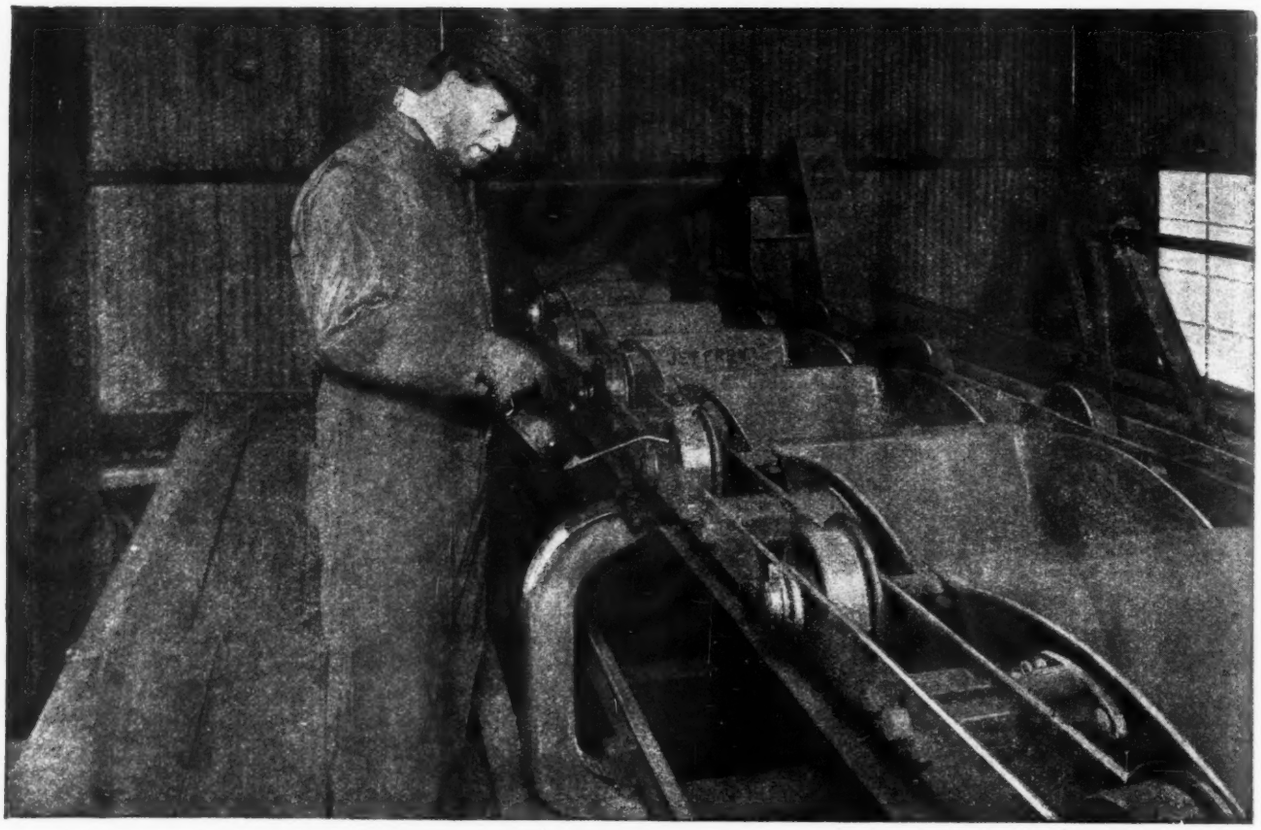
Regulate your boiler in accordance with the amount of steam flowing from the boiler.

THAT'S THE HAGAN WAY

The Hagan Corporation

Combustion Engineers

Peoples Bank Bldg., Pittsburgh, Pa.



The Jeffrey Improved Carrier Built for Reliability

The *Jeffrey Pivoted* Bucket carrier has been built with the idea of giving "reliability first."

Coupled with a maximum of material strength and hardness of wearing surface is the practicability of design enabling the engineer to install to an irregular outline containing curves and inclines as well as in rectangular form.

They require little lubrication, have double bushed chains, dump without shock —and have hardened steel trunnions and pins.

They are made to last and give lasting service.

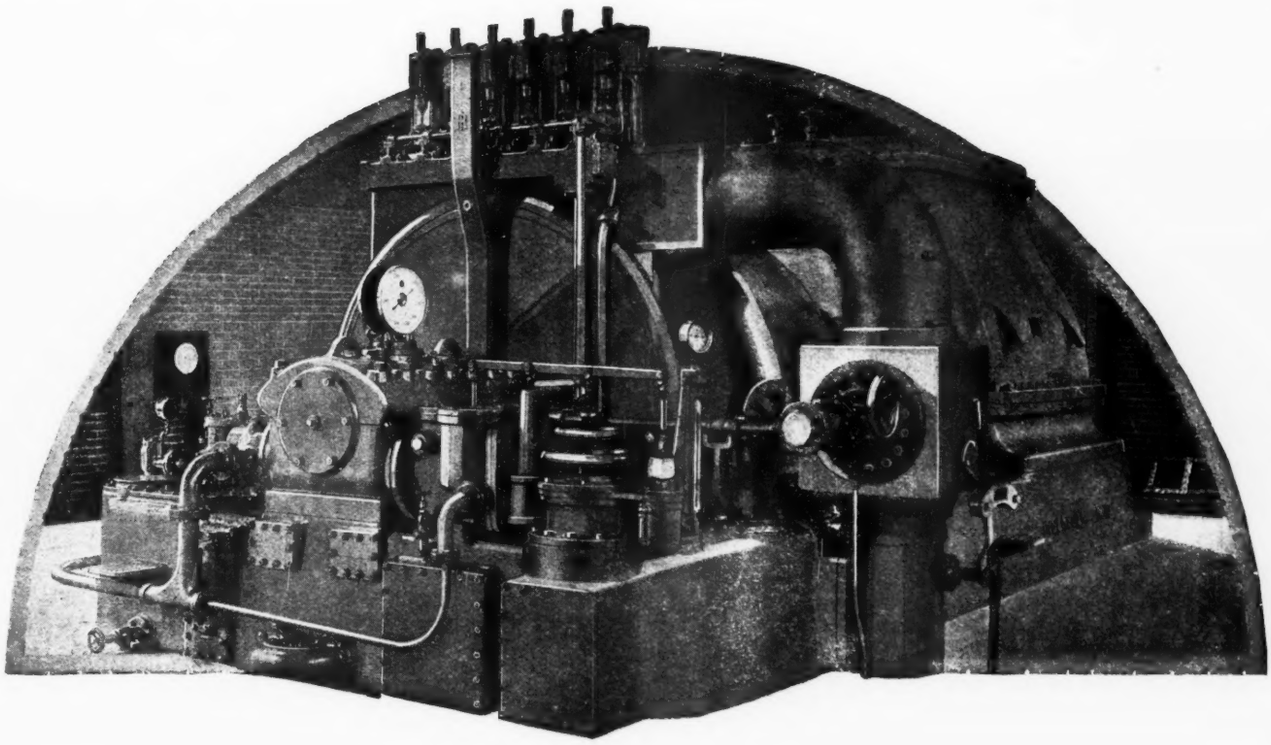
Write for Pivoted Bucket Conveyer Catalog No. 210-H.

THE JEFFREY MANUFACTURING CO.

Columbus, Ohio

New York, Boston, Philadelphia, Scranton, Cleveland, Charlestown W. Va., Pittsburgh, Chicago, St. Louis, Detroit, Birmingham, Dallas, Milwaukee, Los Angeles, Denver, Montreal

Handle it Mechanically



Turbo Blowers and Compressors

I-R Turbo Blowers range in capacity from 3,000 to 60,000 cubic feet per minute, and pressures from 1 pound to 30 pounds. These units are built for use with Iron Blast Furnaces, Bessemer Steel Converters, Oil Furnaces, Copper Blast Furnaces and Converters, Copper Flotation; in fact for all conditions where low pressure air or gas is required.

Where high pressures are required, I-R Turbo Compressors are recommended. These machines are built for pressures up to 110 pounds.

Full information on request

Ingersoll-Rand Company

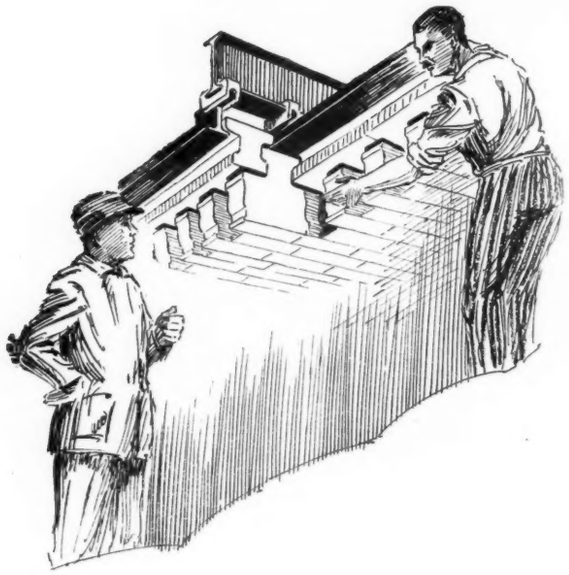
General Offices: 11 Broadway, New York

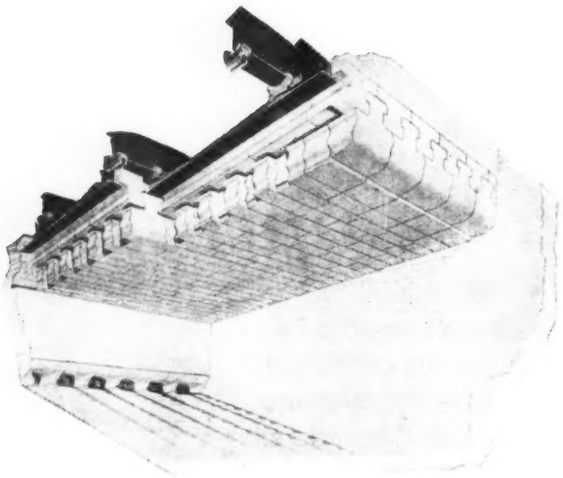
Offices Everywhere

37 T

Ingersoll-Rand

The Inquiring Engineer





What do you mean by Double Suspension?

The double suspension features covered by Liptak patents is a unique and epoch-making development in fire arch construction.

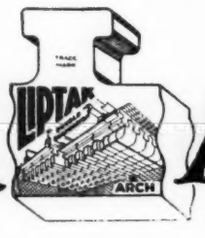
There are technically two arches, the main or lower arch suspended from the secondary or reserve arch. Between these two is a *dead air space*. The secondary arch is in turn separated from the supporting beams by another dead air space. These dead air spaces prevent the escape of heat so thoroughly that you can stand with perfect ease on the arch in your bare feet while the furnace is going at full blast.

Also, the lower arch can be entirely burned away and the boiler doesn't have to come off the line. Repairs can be made at your convenience when the damaged blocks can be slipped into place without special tools, materials or specialized skill.

Liptak Arches assure uninterrupted power, minimum upkeep costs and maximum boiler room efficiency.

It will pay to investigate

Liptak Fire Brick Arch Company
845 Builders Exchange, Minneapolis

LIPTAK 

ARCHES

Write for further information on Liptak Double Suspension Arches

DURABLA

TRADE MARK REG. U. S. PAT. OFF.

STRENGTH—GOODNESS—QUALITY

Patented Aug. 27, 1918

DURABLA ROD PACKING

STEAM HAMMER FACTS

Would you consider first cost of a semi-metallic rod packing that would give you from two to twelve times the service of any other?

DURABLA Rod Packing installed on 2000 lb. steam hammer used every working day in one of the big locomotive plants has given over twelve (12) months' perfect service. The best previous service ever obtained was one (1) month.

This exceptional service is being duplicated daily in hundreds of plants on hammers ranging in size from 1000 to 6000 lbs.

Your steam hammer leaks can be eliminated and your operating costs materially reduced by packing stuffing boxes with DURABLA Rod Packing. A trial is convincing.

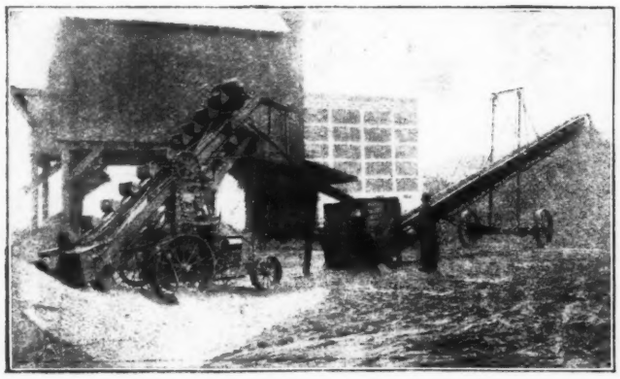
DURABLA Rod Packing is made in 12 ft. lengths, in sizes of 1-16 in. from 1-4 in. upwards, and in spiral form only.

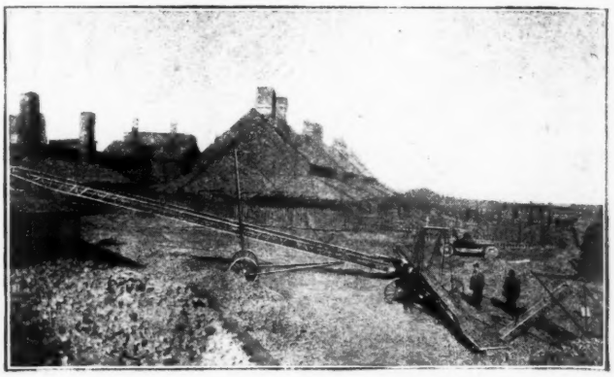
DURABLA MANUFACTURING CO.

New York Chicago Pittsburgh Philadelphia Dallas San Francisco

DURABLA

B-G Systems of Coal Storage





B
STANDARDIZED MATERIAL-HANDLING MACHINES
G

YOU don't need to be told of the necessity of storing coal for next winter now—every steam user realizes that he must protect himself against a possible shut down.

The question is how to store and reclaim—quickly, cheaply, with few men, and without danger of firing.

B-G Self-Feeding Bucket Loaders
B-G Portable Conveyors

Offer the only complete system for this work. Used either singly or in series no other equipment can produce the same results at so small a cost. The flexible portable units fit any job—none too large or to small. From cars to piles or wagons—piles to wagons, cars, or stokers—and for all storage and reclaimation work, B-G is without an equal.

Plants all over the country have found this to be a positive fact. Have you investigated B-G for your job?

Let B-G Engineers work on your problems. This service is free, involves you in no obligation, and is backed by years of experience. It costs you nothing to investigate. Just write for Catalog R.

Barber-Greene Company

AURORA, ILLINOIS, U. S. A.

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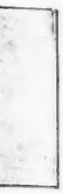
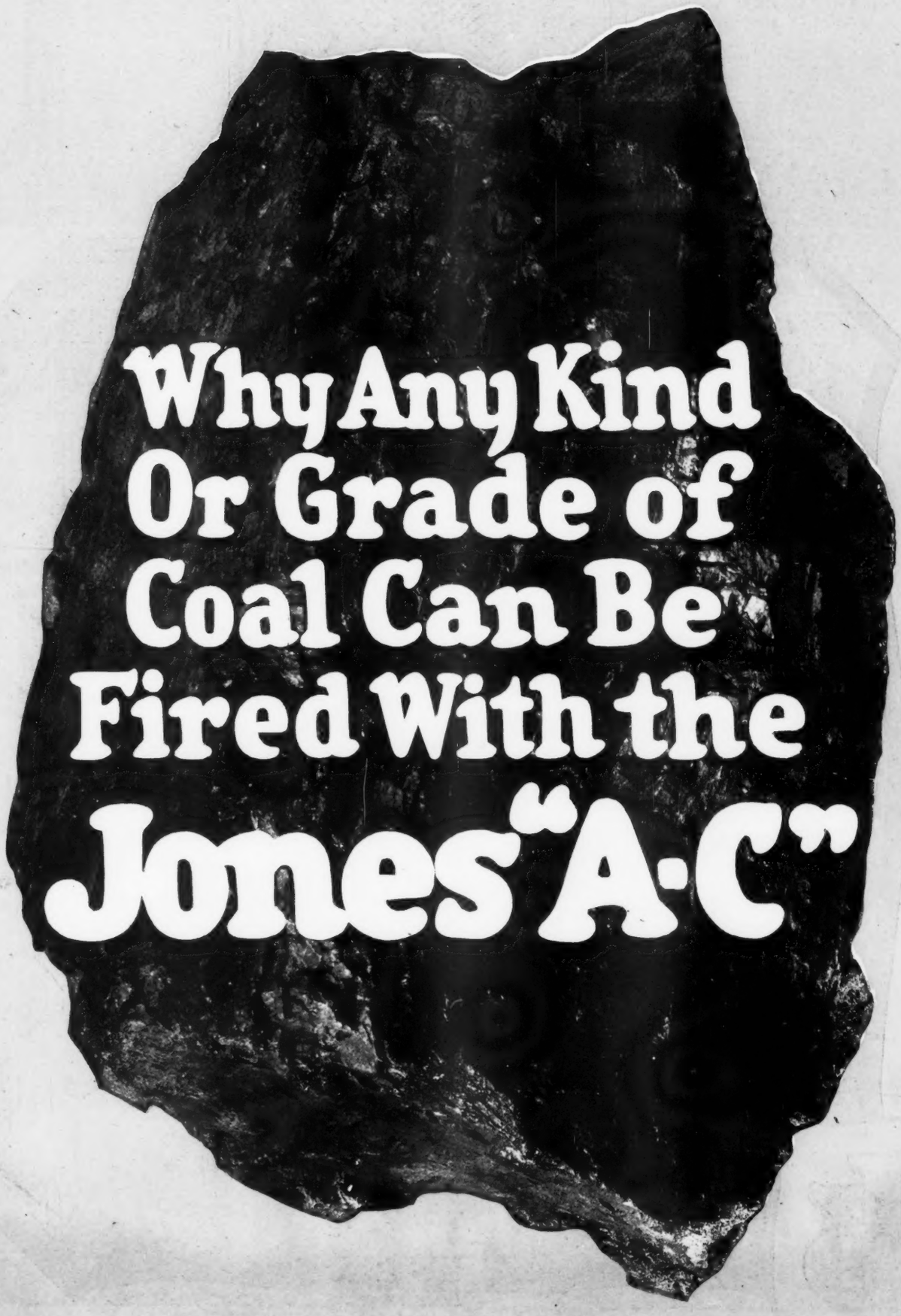
Norfolk	Utica	Pittsburgh	St. Louis	Kansas City	San Francisco
Salem	Cleveland	Chicago	Omaha	Denver	Los Angeles

Canadian Agents: Mussens Limited, Montreal, Winnipeg, Toronto, Vancouver.

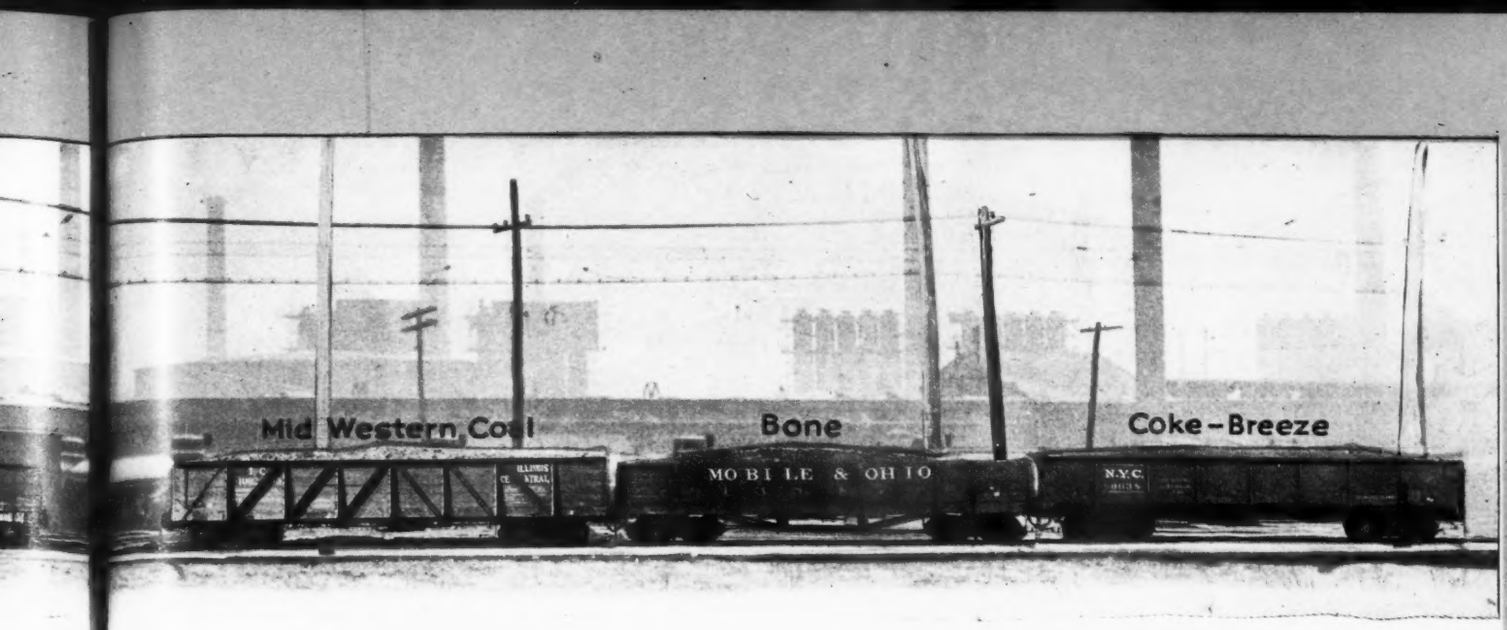
EXPORT DEPARTMENT
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA




Why Any Kind
Or Grade of
Coal Can Be
Fired With the
Jones "A-C"

Interior of power plant, Ohio State University, showing 600 H. P., B. & W. Boiler equipped with six retort Jones "A-C" Stokers. Engineer in charge of equipment and details, W. C. McCracken. Architect, Joseph N. Bradford.

JONES STOKER



Burn Any Available Coal At High Efficiency

THE fuel situation during the last two years has emphasized the fact that it is not enough for a stoker to burn your local coal. It must burn the *available* coal, which means any one of a *number* of coals. Results have proved that plants equipped with the Jones "A-C" are not limited to any one fuel. It burns any available coal at high efficiency because of distinctive features originated by this company and perfected in the Jones "A-C".

Taking Full Advantage of the Jones Under-Feed Principle

Practically all steaming coals have a high volatile content which is best distilled and ignited by the under-feed principle of combustion originated in the Jones Stoker. The retorts of the Jones "A-C" are extremely long, so that the distillation is thorough. The pusher rod, slicing and breaking up the fuel bed, facilitates volatilization. The full heat value of the lowest grades of coal is brought out by this process.

The Jones "A-C" Stoker burns low grades of coal more efficiently than any other stoker, because—

1st—Simplicity and Sturdiness of Construction. Minimum of moving parts, and no moving parts in the fire to burn out or clog up. Stoker so sturdily built as to withstand considerable abuse.

2nd—Slight Inclination of the Retort. The eleven degree slope prevents avalanching on to the dump plate and hot fires at the rear of the stoker, which burn out dump plates, are thus avoided. Moreover, there are no clinker troubles at the bridge wall.

3rd—Accessibility to all Parts of Fuel Bed. Through openings in the front wall, directly over each row of tuyere blocks, every part of the fuel bed is readily accessible, and the fire can be kept in good condition even with the poorest coals.

4th—Individual Control of Retort. Every ram being individually controlled insures a perfect fuel bed over the entire furnace.

5th—Prevention of Clinker on Side Walls. High air cooled side tuyeres prevent the clinker fusing to the brick work on the side walls.

Some Typical Cases

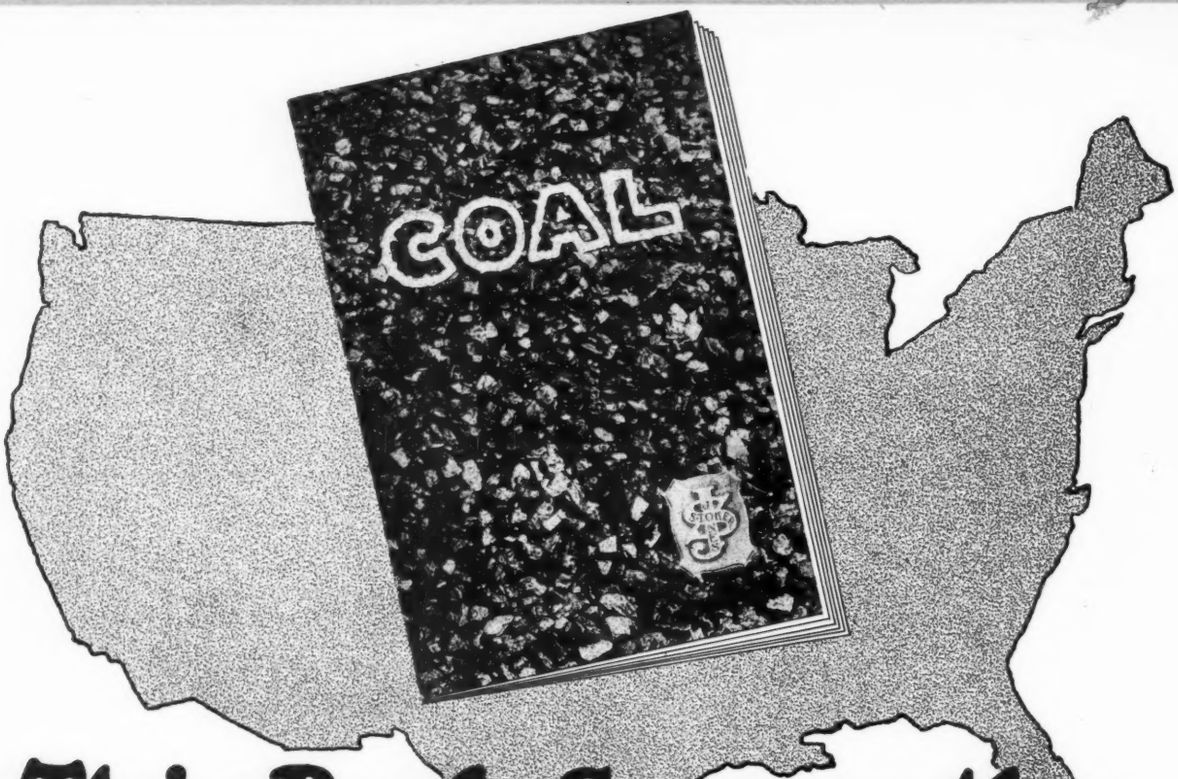
The Big Four Ry., Beech Grove Shops, Indianapolis, Ind., burned 50/50 mixtures of barley anthracite and Indiana Coal, securing 200% boiler ratings.

The Ford Hospital, Detroit, Mich., burned a mixture of 3 parts coke-breeze to one of coal at 150% rating.

The Ebensburg Coal Co., Colver, Pa., burn "bone coal", extremely high in ash and sulphur.

The Chevrolet Motor Co., Flint, Mich., burned "war coal" in which spontaneous combustion had ensued. This coal ran from 8,000 B.T.U. to 12,000 B.T.U. as fired.

The Jones "A-C" Stoker will handle practically anything from lignite to semi-anthracite.



This Book Covers the Coals of Every Fuel District

THIS booklet has been prepared as a help for the user of coal. It contains approximate and ultimate analyses and B. T. U. contents of coals from every mining section of the United States. It may enable you to broaden your fuel market.

Incidentally, it shows how the Jones "A-C" Stoker is perfectly adapted for the burning of the coals of every section. Write (on business stationery) for your copy of this valuable book.

The Under-Feed Stoker Co. of America

General Offices: Book Building, Detroit

Boston	Cincinnati	Minneapolis	Pittsburgh
Buffalo	Cleveland	New Orleans	Saint Louis
Charlotte	Denver	New York	Salt Lake City
Chicago	Kansas City	Philadelphia	Seattle

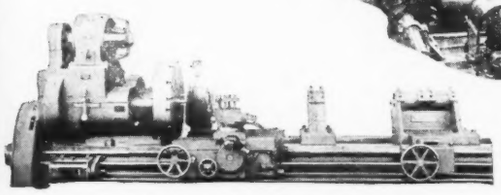
The Under-Feed Stoker Co. of Canada, Ltd., 81 Victoria St., Toronto

Sole manufacturers in the United States and Canada of the Jones Under-Feed Stoker

JONES STOKER

The complete electrification of its mechanical units is one of the greatest progressive movements any industry can undertake today

Electric Motors, direct connected to machines, is the most advanced and advantageous method of operation.



Producers! Adjustable Speed Motor direct connected to lathe.

Storage Battery Truck simplifies material handling problems

Electricity concentrates efficiency

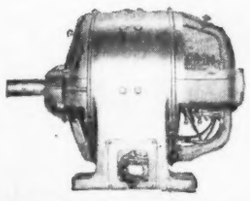
The modern machine shop affords a most striking example of what may be achieved by the electrical operation of its machines and tools.

Nothing is subordinated to power distribution—the machinery is placed in production order, and operated by direct connected electric motors with variable speed control. By this method, compact arrangement of equipment means only concentrated efficiency, for all the desirable space is occupied by productive machines.

The electric system also affords a simple and profitable solution of operating trucks, conveyors, furnaces for tool repair, ventilating fans, and like equipment.

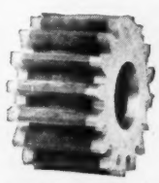
A small increase in production will more than balance the initial expense of the electric plant—there is a marked increase in production at every point where electricity is applied—consider the gain in complete electrification.

43B-501



Reversible Planer Motor—"Makes the chips fly faster."

Good ventilation is imperative—Riveted Frame Induction Motor direct connected to exhaust fan.



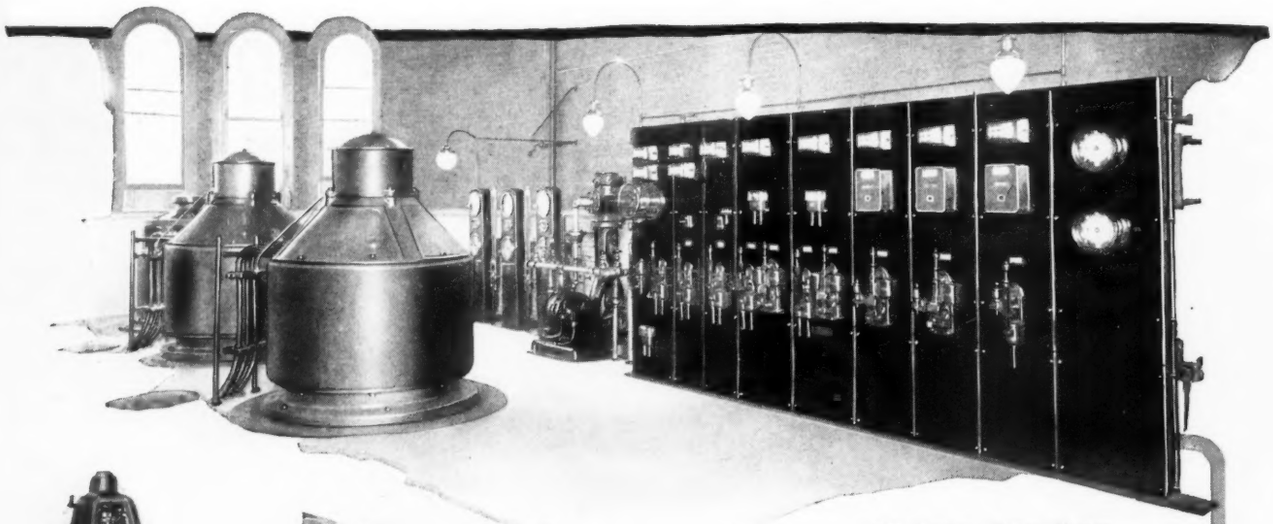
Fabroil Gear—combines durability with silent running.

General Electric Company

General Office Schenectady, N.Y.

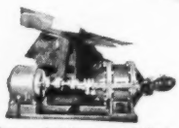
Sales Offices in all large cities

The margin of profit in many industries largely depends upon the efficiency, dependability, and low upkeep cost of machinery used

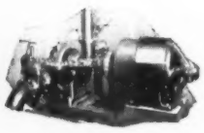


G-E Vertical Pump Motors give powerful, efficient service in this water pumping station.

Vertical Motor direct drive for centrifugals or pumps.

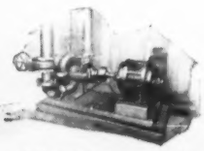


Dependable operation of motor-driven pump under severe conditions in mining.

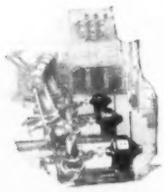


Protect your industry with motor-driven fire pumps.

Widespread developments in irrigation through use of motor-driven pumps.



Motor driving supply pump in sugar mill.



Motors direct connected to centrifugal pump—6000 gallons of water per minute

Electrically driven pumps raise the margin

Pumping costs receive careful scrutiny in the economical management of many industrial properties. Consideration of the most satisfactory solution of the varied problems involved leads to electric drive in which G-E Motors and attending equipment are specified.

Pumping stations, mills, mines, textile factories, chemical plants, irrigation developments — all have presented diversified requirements in adopting electric pump drive.

Through intelligent co-operation with G-E specialists, the pump manufacturer has been able to produce the proper pump and the most efficient form of drive for each installation.

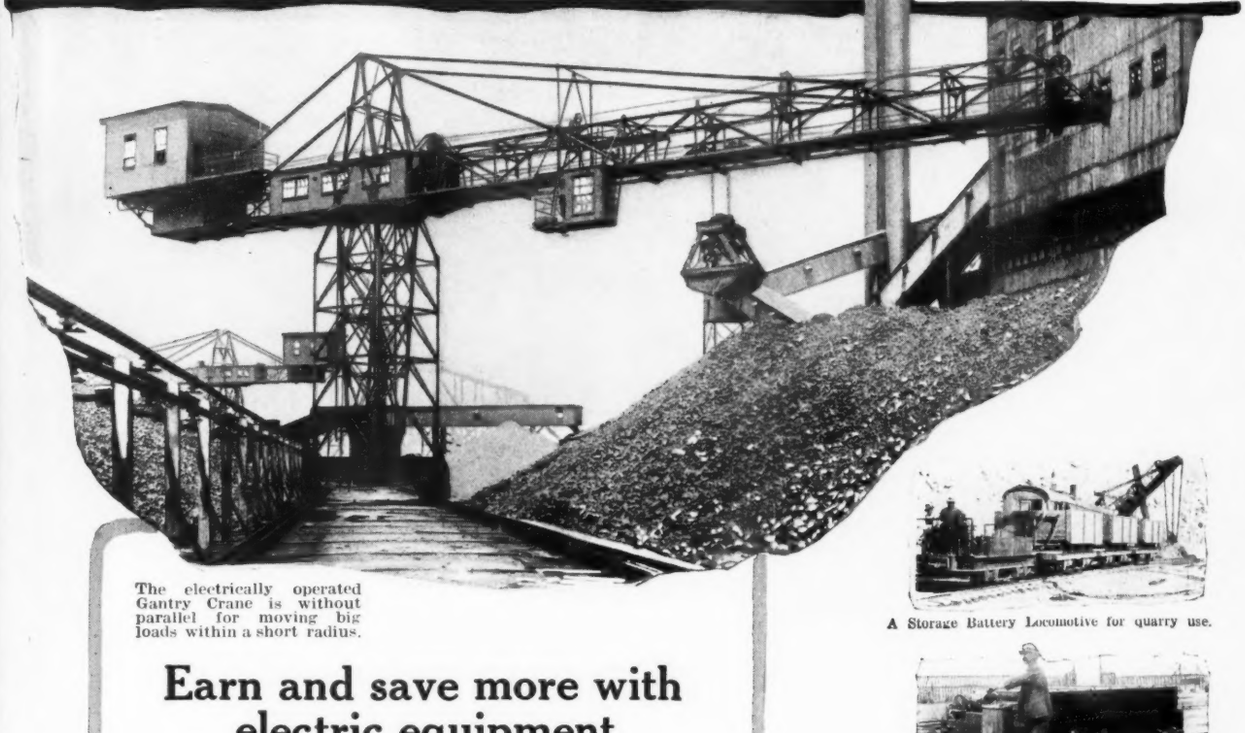
Securing the electric equipment and co-operative service of the General Electric Company through the manufacturer of pumps and other machinery, is to combine the greatest efficiency and dependability in the application of electric power to your plant.

General Electric Company

General Office Schenectady, N.Y.

Offices in large cities

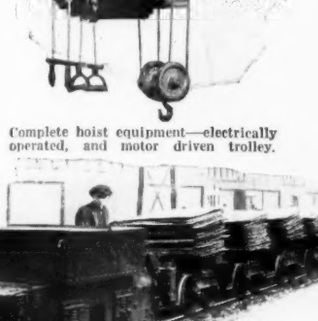
The profit column of the industrial ledger shows a consistent gain when electricity is applied to material handling machines



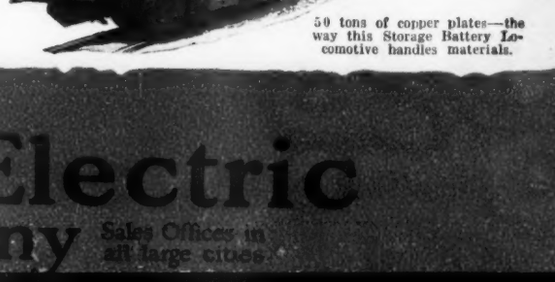
The electrically operated Gantry Crane is without parallel for moving big loads within a short radius.

A Storage Battery Locomotive for quarry use.

This locomotive is essential to the proper handling of materials in industrial yards.



Complete hoist equipment—electrically operated, and motor driven trolley.



50 tons of copper plates—the way this Storage Battery Locomotive handles materials.

Earn and save more with electric equipment

The problems of material handling in modern industry require up-to-date methods of solving them—electricity alone can keep pace with the times.

It has been demonstrated in numerous installations, some of which are illustrated herewith, that electrically operated and controlled equipment is the most flexible, most rapid of material handling machinery—and contributes reliability, economy and high efficiency to production, the receipt of raw goods and the shipment of finished products.

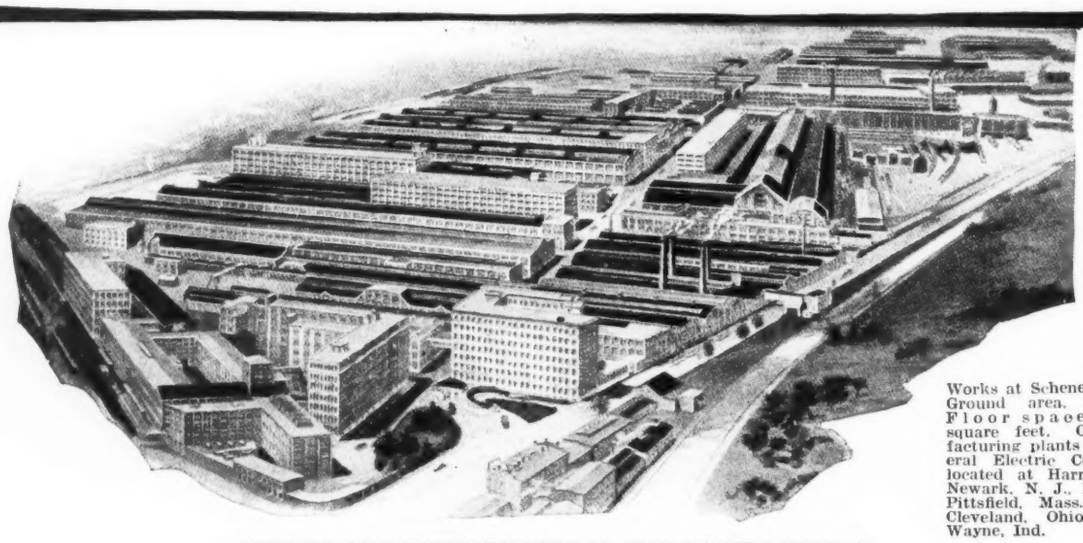
When you submit your material handling problems to a manufacturer of this equipment, *specify G-E Motors and Electric Control.* This insures you specialized service of General Electric Company engineers co-operating with the manufacturer in satisfying your individual needs.

General Electric Company

General Offices: Schenectady, N. Y. Sales Offices in all large cities

Where to Get G-E Service—

Quick service is best obtained from the nearest G-E sales office, distributing jobber, or foreign representative



Works at Schenectady, N. Y. Ground area, 340 acres. Floor space, 5,800,000 square feet. Other manufacturing plants of the General Electric Company are located at Harrison, N. J., Newark, N. J., Lynn, Mass., Pittsfield, Mass., Erie, Pa., Cleveland, Ohio, and Fort Wayne, Ind.

OFFICES AND DISTRIBUTORS IN THE UNITED STATES

G-E Sales Office	G-E Distributing Jobber
Alabama, Birmingham	Matthews Elec. Supply Co.
Alabama, Mobile‡	Matthews Elec. Supply Co.
Arkansas, Little Rock	
California, Los Angeles†	Pacific States Electric Co.
California, Oakland‡	Pacific States Electric Co.
California, San Francisco§†	Pacific States Electric Co.
Colorado, Denver†	The Hendrie & Bolthoff Mfg. & Sup. Co.
Connecticut, Hartford	
Connecticut, New Haven	
Connecticut, Waterbury†	New England Eng. Co
District of Columbia, Washington	National Elec'l Supply Co.
Florida, Jacksonville	Florida Elec. Supply Co.
Florida, Tampa‡	Florida Elec. Supply Co.
Georgia, Atlanta§†	Carter Electric Company.
Georgia, Savannah‡	Carter Electric Company.
Illinois, Chicago§†	Central Electric Company. Commonwealth Edison Co.
Indiana, Fort Wayne	
Indiana, Indianapolis	Indianapolis Elec. Supply Co.
Indiana, South Bend‡	South Bend Electric Co.
Iowa, Des Moines	Mid-West Electric Co.
Kentucky, Louisville	Belknap Hardware & Mfg. Co., Inc.
Louisiana, New Orleans	Gulf States Electric Co., Inc.
Maryland, Baltimore	Southern Electric Co.
Massachusetts, Boston†	Pettingell-Andrews Co.
Massachusetts, Springfield	
Massachusetts, Worcester	
Michigan, Detroit	Frank C. Teal Company.
Michigan, Grand Rapids	
Minnesota, Duluth	Northwestern Electric Equip. Co.
Minnesota, Minneapolis†	Peerless Electrical Company.
Minnesota, St. Paul‡	Northwestern Elec. Equipment Co.
Missouri, Joplin†	
Missouri, Kansas City†	The B-R Electric Co.
Missouri, St. Louis†	Wesco Supply Company.
Montana, Butte†	Butte Electric Supply Co.
Nebraska, Omaha	Mid-West Electric Co.
New Jersey, Newark‡	Tri-City Electric Co., Inc.

‡No G-E Office

G-E Sales Office	G-E Distributing Jobber
New York, Albany‡	Havens Electric Co., Inc.
New York, Buffalo	Robertson-Cataract Elec. Co.
New York, Elmira	
New York City§†	E. B. Latham & Company. Royal Eastern Elec'l Sup. Co. Sibley-Pitman Elec. Corp.
New York, Niagara Falls	
New York, Rochester	Wheeler-Green Elec'l Sup. Co.
New York, Schenectady	
New York, Syracuse	Mohawk Elec'l Supply Co.
North Carolina, Charlotte	
Ohio, Cincinnati†	The F. D. Lawrence Elec. Co.
Ohio, Cleveland	Republic Electric Co.
Ohio, Columbus	The Erner & Hopkins Co.
Ohio, Dayton	The Wm. Hall Electric Co.
Ohio, Toledo	W. G. Nagel Electric Co.
Ohio, Youngstown	
Oklahoma, Oklahoma City†	Southwest G-E Co.
Oregon, Portland†	Pacific States Electric Co.
Pennsylvania, Erie	
Pennsylvania, Philadelphia§†	Philadelphia Elec. Co. Sup. Dept.
Pennsylvania, Pittsburgh†	Union Electric Company
Rhode Island, Providence	
South Carolina, Columbia‡	Perry-Mann Elec. Co., Inc.
Tennessee, Chattanooga	James Supply Company.
Tennessee, Knoxville	
Tennessee, Memphis	Electric Supply Company.
Tennessee, Nashville	
Texas, Dallas†	Southwest G-E Co.
Texas, El Paso†	Southwest G-E Co.
Texas, Houston†	Southwest G-E Co.
Utah, Salt Lake City†	Capital Electric Company.
Virginia, Richmond	Southern Electric Company
Washington, Seattle†	Pacific States Electric Co.
Washington, Spokane	
Washington, Tacoma	
West Virginia, Charleston	
Wisconsin, Milwaukee	

For Hawaiian business address Catton, Neill & Co., Ltd., Honolulu.

†Warehouse. §Service Shop.

Distributors for the General Electric Company Outside of the United States

INTERNATIONAL GENERAL ELECTRIC COMPANY, INC.

New York, 120 Broadway — **Schenectady, N. Y.** — **London, 83 Cannon St.**

Agents and Representatives

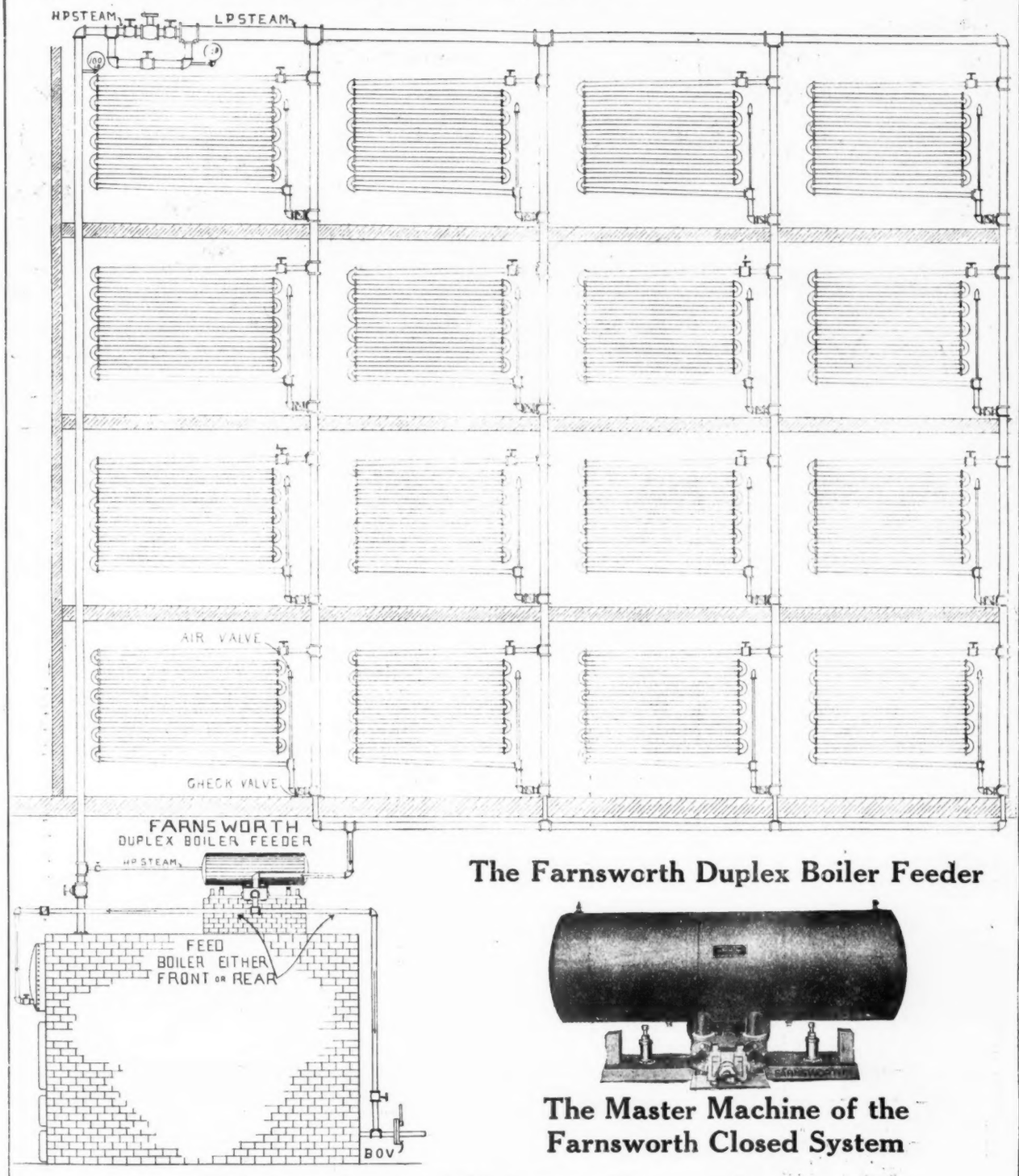
Argentina: General Electric, S. A., Buenos Aires.
Australia: Australian General Electric Company, Ltd., Sydney and Melbourne
Belgium and Colonies: Societe d'Electricite et de Mecanique Procedes Thomson-Houston & Carels, Societe Anonyme, Brussels, Belgium.
Bolivia: International Machinery Company, La Paz and Oruro.
Brazil: General Electric, S. A., Rio de Janeiro and Sao Paulo.
Canada: Canadian General Electric Co., Ltd., Toronto.
Chile: International Machinery Company, Santiago, Antofagasta and Valparaiso
China: Andersen, Meyer & Company, Ltd., Shanghai. International General Electric Co. Inc., (General office for the Far East excluding Japan and China) Shanghai.
Colombia: Wesselhoeft & Poor, Bogota and Barranquilla.
Cuba: General Electric Company of Cuba, Havana.
Dutch East Indies: International General Electric Co., Inc., Soerabaia, Java.
Ecuador: Carlos Cordovez, Guayaquil and Quito
Egypt: British Thomson-Houston Co., Ltd., Cairo.
France and Colonies: Compagnie Francaise Thomson-Houston, Paris.
Great Britain and Ireland: British Thomson-Houston Co. Ltd., Rugby, England. International General Electric Co. Inc., London, E. C. 4.
Greece and Colonies: Compagnie Francaise Thomson-Houston, Paris, France.
India: British Thomson-Houston Co. Ltd., Calcutta and Bombay. International General Electric Co. Inc., Calcutta.
Italy and Colonies: Franco Tosi Societa Anonima, Milan.
Japan: Shibaura Engineering Works, Tokyo. Tokyo Electric Co. Ltd., Kawasaki-Kanagawa-Ken.
Mexico: Mexican General Electric Company, City of Mexico and Guadalajara.
New Zealand: National Electrical & Engineering Co. Ltd., Auckland Dunedin, Christchurch and Wellington.
Paraguay: General Electric, S. A., Buenos Aires, Argentina.
Peru: W. R. Grace & Co., Lima.
Philippine Islands: Pacific Commercial Company, Manila.
Porto Rico: International General Electric Co., Inc., San Juan.
Portugal and Colonies: Compagnie Francaise Thomson-Houston, Paris, France.
Russia: Wseobshtchaia Electricheskaia Kompania, Petrograd and Vladivostok
Spain and Colonies: Compagnie Francaise Thomson-Houston, Paris, France.
South Africa: South African General Electric Co. Ltd., Johannesburg and Capetown.
Uruguay: General Electric, S. A., Montevideo.
Venezuela: Wesselhoeft & Poor, Caracas.

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

Showing the Farnsworth Closed Loop Boiler Feeding System With the Farnsworth Duplex Boiler Feeder Draining an Overhead One Pipe Coil System—



The Farnsworth Duplex Boiler Feeder

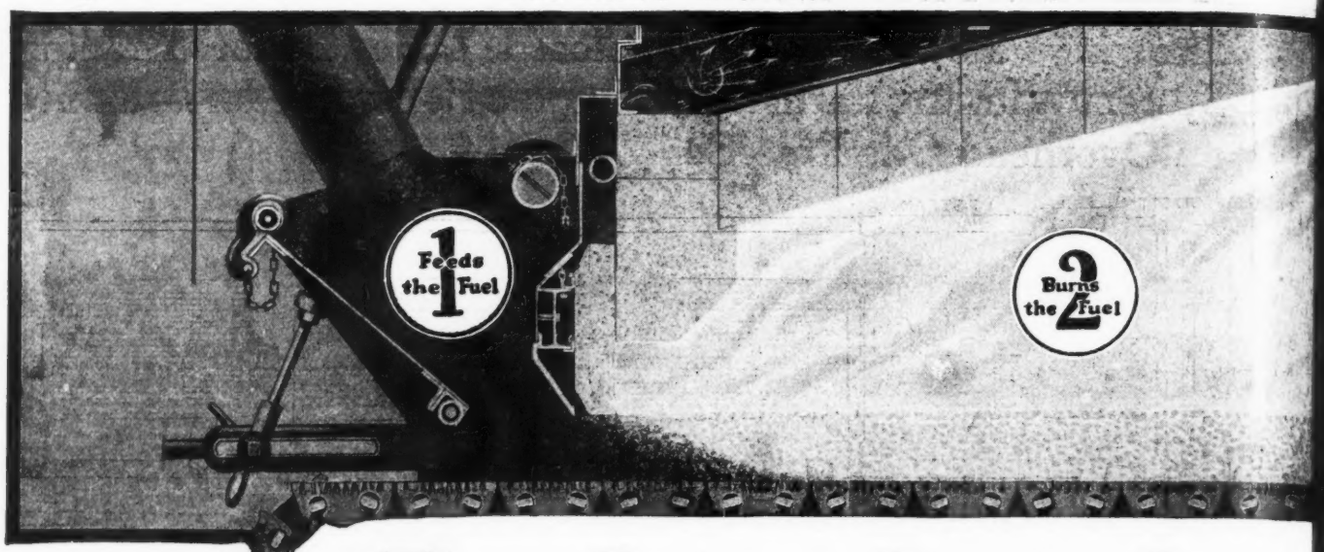
The Master Machine of the Farnsworth Closed System

Write for explanation of this System and its many advantages

Farnsworth Company, Conshohocken, Pa.

Canadian Farnsworth Company, Toronto, Canada

Refer to Some of Our 150 Full Pages in Power in Last 3 Years



4 Clears the Grate Surface

The Green Chain Grate

—The Nearest Approach to

DO YOU remember when they were called **automatic** stokers? The word "automatic" symbolized the unprecedented economies that were born with stoker firing. It has been dropped because today all stokers are in some sense automatic.

The thinking engineer is no longer interested in whether a stoker is called automatic—he inquires, "to what degree is it automatic?" He demands engineering reasons and operating proofs.

The Green Chain Grate has both.

The Green-equipped plants illustrated have a characteristic record of labor and fuel saving. The story of ease of manipulation, continuous operation without stopping to clean fires or handle clinker, and the certain result: fewer firemen who are more contented—is a conspicuous part of the operating-record of **all** Green installations.

The truly automatic operation of the Green Chain Grate made possible the elimination of two firemen at $100.00 per month in the plant of the C. St. P. M. & O. Ry. at Minneapolis. The engineer of this plant also reports an $18,000.00 per year fuel saving.

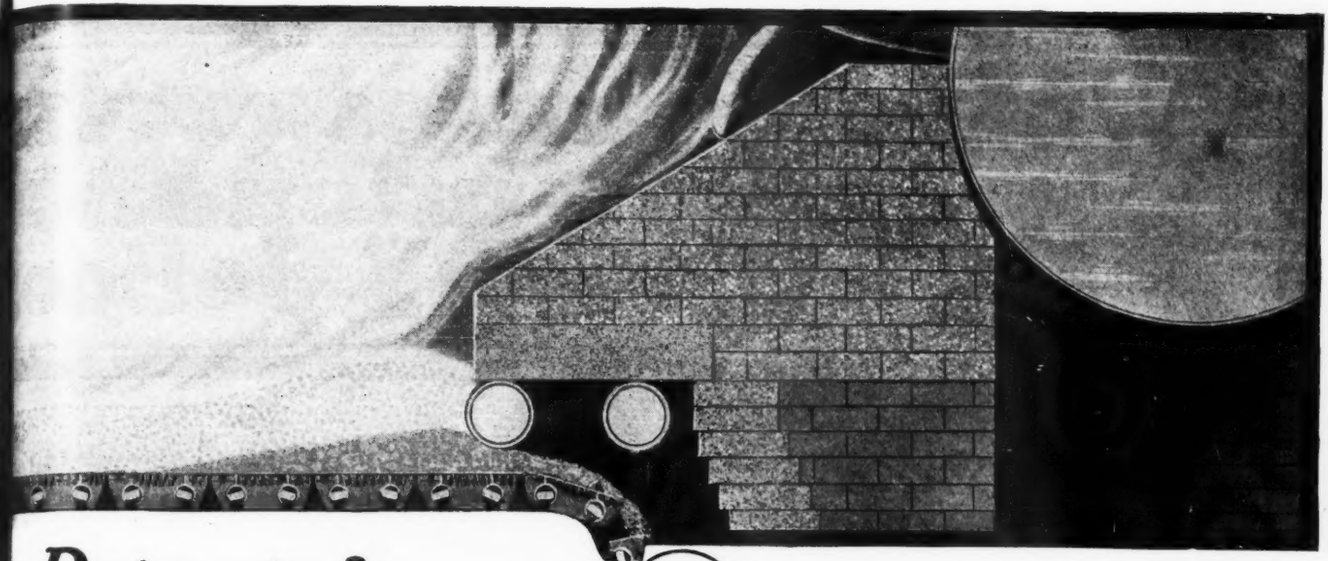
GREEN ENGINEERING

Main Office and Shops:

Backed by 23 Year of Specialized Experience

Green Sealflex Arches
Green Pressure Waterbacks
Green Steam Jet Ash Conveyor
Green Cast Iron Ash Tank

GREEN



Principle 3 Discharges the Ash

Completely Automatic Firing

The operating principle of the Green Chain Grate is responsible for this. The Green:

1—**Feeds the Fuel**—feeds it automatically to any depth of fuel bed.
2—**Burns the Fuel**—burns it thoroughly without forming clinker, without stopping to clean fires, etc.—in short, burns it automatically.
3—**Discharges the Ash**—automatically and continuously.
4—**Automatically cleans the air spaces of the Grate Surface**—insures proper air supply.

It does all this in **one continuous operation**—truly the nearest approach to entirely automatic firing!

The 92 page Green Book, PROGRESSIVE COMBUSTION takes up the advantages of automatic operation in detail. It also contains a quantity of useful firing facts. Write for your copy to Dept. A (on business stationery).

Driving engine requires but 30 lb. steam per hr. for the largest stoker—no other steam consuming auxiliaries—all efficiency figures quoted are net.
No clinker—least attendant labor.

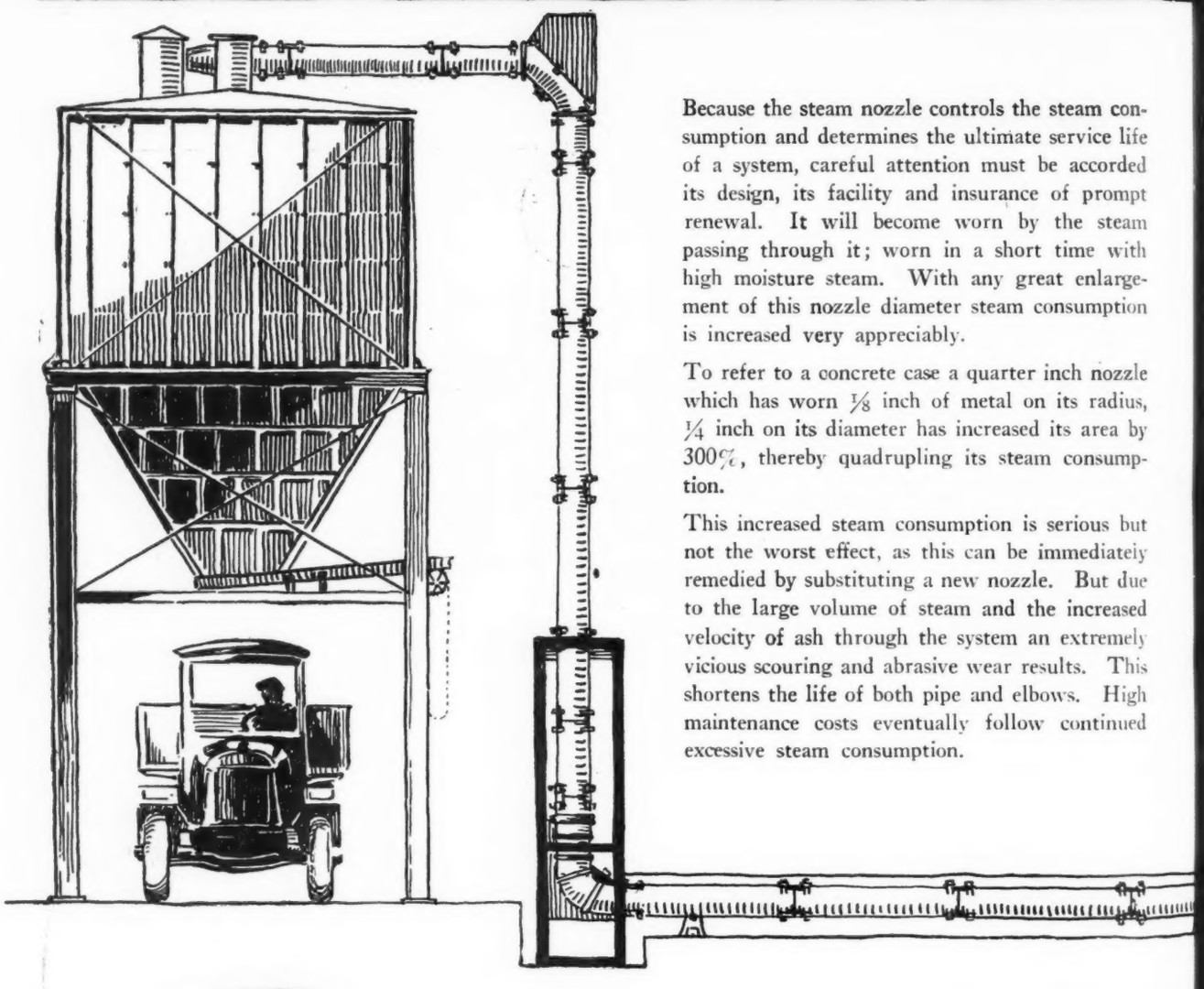
Two hundred per cent of rating continuously with Iowa coal containing 25% ash is the record of the Citizens Gas and Electric Co. of Waterloo, Ia., a Green - fired plant. There is no stopping to clean fires so the complete automatism of Green Stokers results in a big decrease in labor costs.

COMPANY
EAST CHICAGO, INDIANA

CHAIN GRATES

"K" Type for Clinkering Coals "L" Type for Coking Coals

What eliminates excess and maintenance Green-S-J-Boo



Because the steam nozzle controls the steam consumption and determines the ultimate service life of a system, careful attention must be accorded its design, its facility and insurance of prompt renewal. It will become worn by the steam passing through it; worn in a short time with high moisture steam. With any great enlargement of this nozzle diameter steam consumption is increased very appreciably.

To refer to a concrete case a quarter inch nozzle which has worn ⅛ inch of metal on its radius, ¼ inch on its diameter has increased its area by 300%, thereby quadrupling its steam consumption.

This increased steam consumption is serious but not the worst effect, as this can be immediately remedied by substituting a new nozzle. But due to the large volume of steam and the increased velocity of ash through the system an extremely vicious scouring and abrasive wear results. This shortens the life of both pipe and elbows. High maintenance costs eventually follow continued excessive steam consumption.

GREEN

...ssive steam consumption ...ncosts? The new ...oexplains fully.

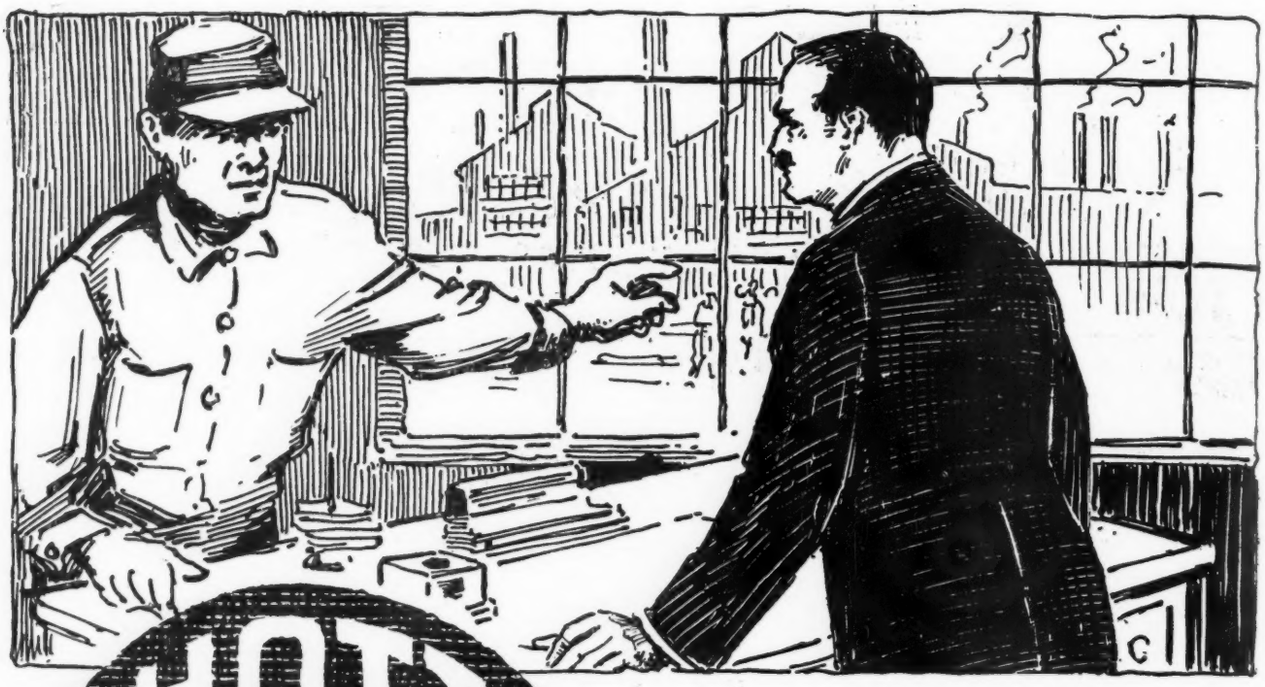
The solution of the steam nozzle problem is not complicated when well understood. It consists in providing a nozzle which will automatically throw the system out of service when steam consumption exceeds a predetermined amount. Then, and only then, can steam consumption and maintenance remain at a low figure.

These two long striven for results are secured and guaranteed by the newly developed Green *Signal* Nozzle. This and many other elements new in steam jet design are fully explained in the new "S-J" Ash Conveyor Book. Write for your copy to Dept. A.

Write Dept A for your copy

Green Engineering Company
40 Kennedy Ave., East Chicago, Indiana

...N Steam Jet Ash Conveyor



HOTT PATCH FURNACE CEMENT

Patented Jan. 13, 1920

Prevent Collapsed Furnace Arches

It Can Be Done—

Yes sir—your fire brick linings can be built to give long enduring service without shutting down for repairs—even if you are driving your boilers above 300% rating during the peaks—by building your furnace settings with HOTT-PATCH Furnace Cement.

Clinkers Won't Stick

Not a clinker will bother you because the chemical composition of HOTT-PATCH will tolerate no clinker formation. This is positive and guaranteed by us in full.

Excess air and gas leakage are eliminated by the glazed protective coating of Hott-Patch applied to the lining surface. The settings are made positively tight.

HOTT-PATCH should be used for baffle, door arches, bridge wall banking and for molding special blocks and shapes for furnace walls.

To prove its worth for any and all furnace conditions we will ship HOTT-PATCH on approval with freight prepaid east of the Mississippi River and as far south as Atlanta, Ga. If it doesn't do all we claim—the expense is ours.

Write for full particulars now.

ESTABLISHED 1874

THE S. OBERMAYER CO.,

2833 Smallman St., Pittsburgh, Pa.

FACTORIES: **Chicago, Cincinnati, Rillton, Pa.**
WAREHOUSES: **St. Louis, Pittsburgh, Denver, Los Angeles**
OFFICES: **Philadelphia, Milwaukee, Detroit**
New York: Room 1906, 303 Fifth Ave.

EVERYTHING YOU NEED IN YOUR FOUNDRY

Let the Republic be Your Guide

It is a recognized fact that without some form of guide there is a natural tendency for the fireman, at any time more steam is wanted, to force those boilers which are already doing the greatest amount of work.

The Republic System however affords a positive and direct indication as to which fires need attention. The momentary output of each boiler is shown on the Indicating instruments which are placed on the boiler plant.

The total output of each individual boiler is shown on the integrating instruments and the daily record of both output and consumption is recorded on the recording instruments—these may be grouped on a central board at any convenient point—only possible in the Republic System—the only electrically operated flow meter.

Your copy of the bulletin gives the details. Write for it.

General Offices and Factory

REPUBLIC FLOW METERS CO.

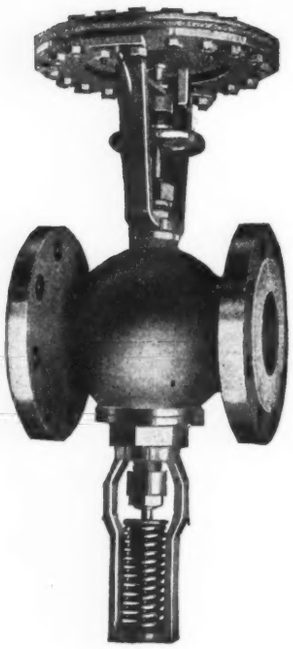
565 Washington Blvd., Chicago

FACTORY BRANCHES

New York Philadelphia Boston Pittsburgh Detroit Atlanta

Republic Flow Meters Co. of Canada, Ltd., Toronto, Ont.

Republic Flow Meters



For Boiler Efficiency

"S-C" Feed Water Regulators

Their use means increased boiler economy by the automatic control of the feed input to maintain the required steam delivery with more constant working of the furnace.

On steady load the feed equals the evaporation and a constant water level is carried.

On variable load, the "S-C" Regulators vary the level to maintain the most efficient height of water for each change in load. They drop the water level when a peak comes on to permit the immediate furnace output to make more steam because of the decreased demand upon it for heating water. When the load changes to light, they raise the water level and store the furnace heat which is no longer necessary to keep up the high steam production, in the water, instead of permitting it to pass up the stack. This stored heat is then utilized when the load increases and will assist the boilers in making steam.

Easily installed on any boiler, but each installation is the result of a careful engineering study of the plant conditions and not a mere adaption of a standard regulator taken from stock.

Ask us to give full details.
Write for Bulletin No. 70.

The "S-C" Regulator Mfg. Company

Feed Water Regulation Engineers

Fostoria, Ohio

GARLOCK

Pump Valves

The service of pump valves depends upon the compounds as well as the consistency and cure of the valves. The compounds used in Garlock pump valves have been established after years of trial in actual service and under the most severe conditions. Pump valves should always be used for the purposes for which they are intended. The following are a few of our leading styles and grades of valves:

Style No. 139—For medium pressure cold water
" " 175—For high pressure cold water
" " 182—For warm or greasy water
" " 108—For hot water
" " 105—For boiling water
" " 154—For air compressors and condensers

We guarantee our pump valves to give satisfactory service when used under conditions for which they are intended.

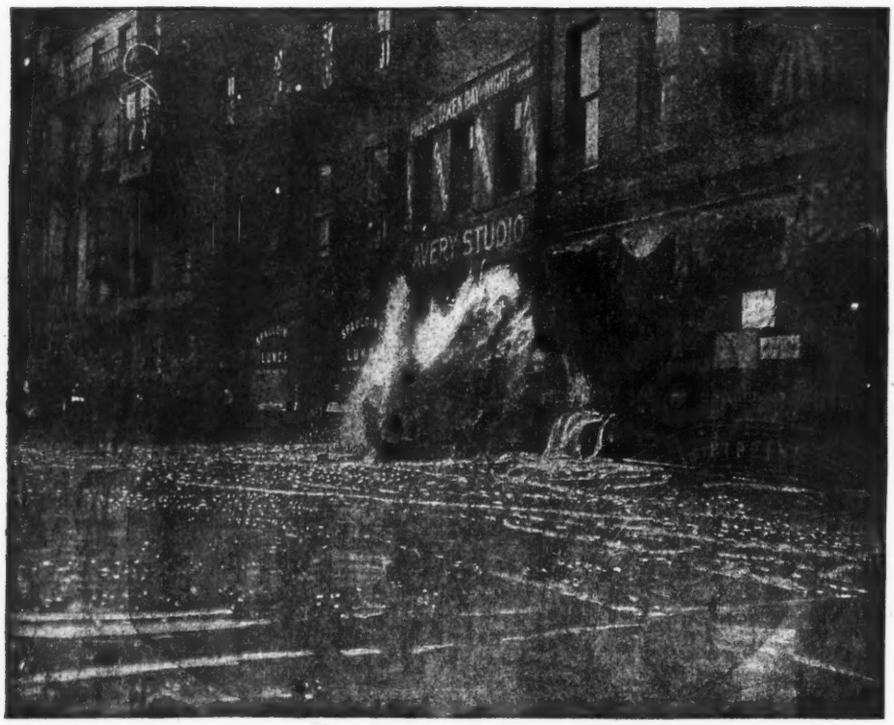
THE GARLOCK PACKING COMPANY

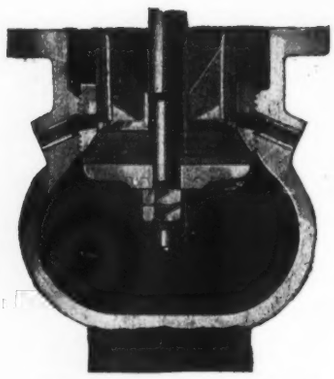
Palmyra, New York

BRANCH OFFICES:

New York	Boston	Denver	Detroit
Chicago	Cleveland	New Orleans	Cincinnati
Philadelphia	San Francisco	Birmingham	Baltimore
St. Louis	Pittsburgh	Salt Lake City	Seattle
Buffalo	Kansas City	Milwaukee	Portland, Ore.

Accidents





Sectional view of Kennedy "Newtype" Fire Hydrant, showing how water pressure keeps the valve tight. Also, showing the anti-freezing feature and avoidance of pockets, explained in special bulletin, sent on request.

A collision, a runaway horse, an automobile beyond control, a careless driver—we read every day of accidents that are liable to, and very often *do,* cause the breaking off of fire hydrant tops. Their exposed positions render them particularly subject to such mishaps, which, unless properly provided against, cause loss of water, property damage and even danger to life.

The Kennedy "Newtype" Fire Hydrant is designed to automatically and effectively prevent loss of water and consequent damage due to flooding or breaking. In closing, the inlet valve operates in the same direction as pressure from the main, so that when closed, the water pressure aids the action of the stem in keeping the valve tight. Should tension on the valve stem be suddenly relaxed, therefore, as in the event of the accidental smashing of the upper part of the hydrant, the water pressure alone automatically maintains the valve in closed position.

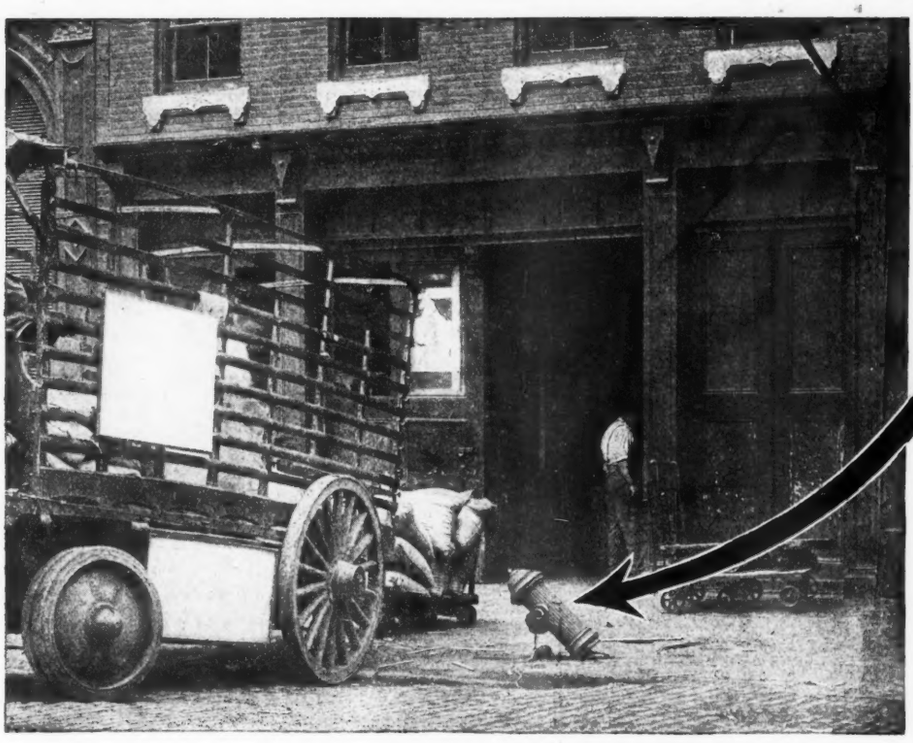
THE KENNEDY

BRANCH OFFICES: New York, 95 John Street; Boston, 47 India Street; Chicago, 204-8 North Jefferson Street; San Francisco, 23-25 Minna Street.
EXPORT OFFICE: 95 John Street, New York.

s will happen—

that's why it pays to get KENNEDY Hydrants—

They're flood-proof even when broken



Furthermore, this advantage is secured without special mechanism in the "Newtype" Fire Hydrant so that even after a long period of inaction its operation is assured.

This flood-proof feature is only a single one of the many special characteristics of the Kennedy "Newtype" Fire Hydrant. Its construction also eliminates danger of breakage from freezing, permits easy inspection and removal of internal working parts without in any way disturbing the standpipe, digging up the street or disconnecting the main, and assures low service cost by simplicity, interchangeability and high quality. Our Hydrant Bulletin fully explains these features. Send for it.

Have you the general Kennedy Catalog?

Y VALVE MFG. CO.

SALES OFFICES: Philadelphia, Continental Hotel Bldg.; Kansas City, 208 Mutual Bldg.; Salt Lake City, 502 Dooly Bldg.; Seattle, L. C. Smith Bldg.; Portland, Ore., Railway Exchange Bldg.; El Paso, 704 Two Republics Bldg.; Winnipeg, Chamber of Commerce Bldg.

175

Here's the Vise, Boys, that holds the pipe still. It centers automatically

You just lay the pipe up against the dies and turn the wheel at the top of the machine. These screws on the side are made so that the top jaw lowers and the bottom jaw rises just enough to grip the pipe plumb in the center of the die-head. So, you see, the threading or cutting is bound to be perfect — it can't be anything else.

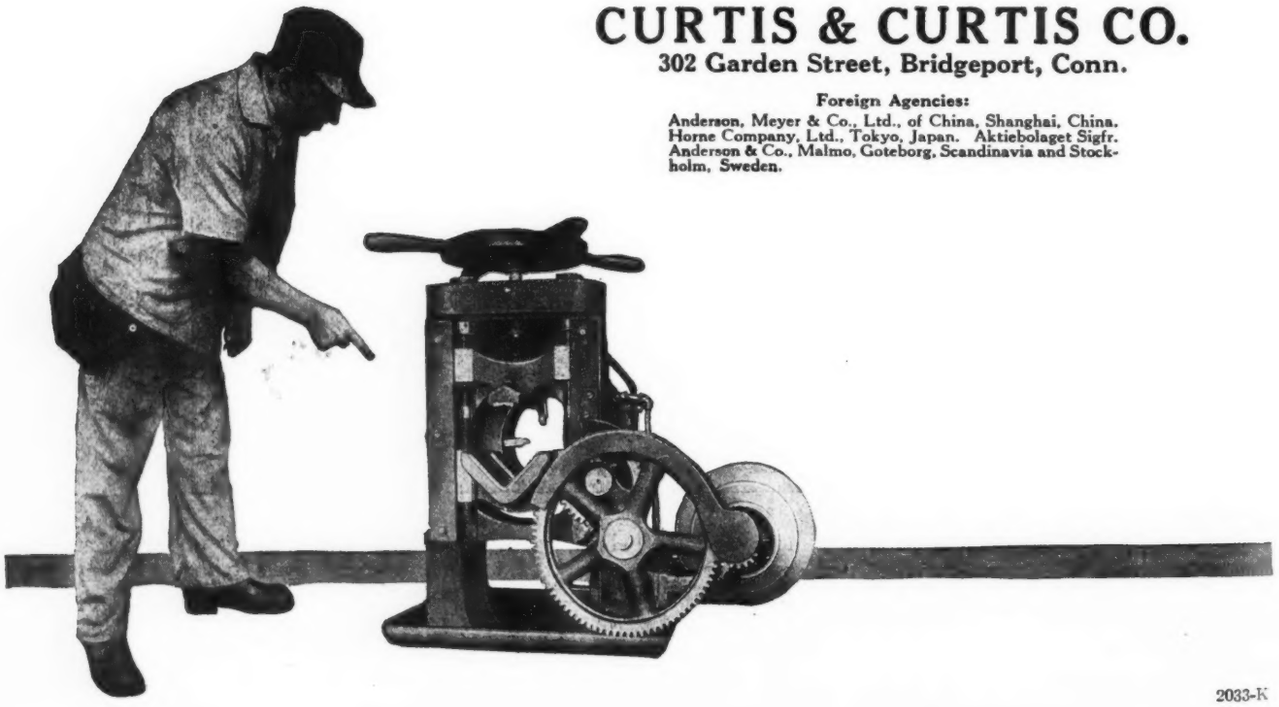
Then, holding the pipe still, with the dies just riding around and the die head sliding back as the thread is cut, takes a heap of strain off the dies. In other machines where the pipe is turned, it's just about impossible to put a thread on anything but a straight piece of pipe, and a lot more power is needed. But with this Forbes' Pipe Threading and Cutting Machine you can thread and cut straight or bent pipe or assembled pieces.

There is a Forbes' to suit your pipe threading and cutting requirements. Made in sizes to handle pipe from one-quarter to 15 inches in diameter, and for hand, belt or motor drive, with or without cast iron base. Write for the details, stating the approximate pipe sizes you handle, and the power available.

CURTIS & CURTIS CO.

302 Garden Street, Bridgeport, Conn.

Foreign Agencies:
Anderson, Meyer & Co., Ltd., of China, Shanghai, China. Horne Company, Ltd., Tokyo, Japan. Aktiebolaget Sigfr. Anderson & Co., Malmo, Goteborg, Scandinavia and Stockholm, Sweden.



2033-K

FORBES'

IT THREADS PIPE ACCURATELY

TRADE-MARK CROSBY

TRADE-MARK CROSBY

Crosby Pressure Gage

NO QUIVERING OF THE POINTER

Correct gage readings are easily noted on the

Crosby Improved Pressure Gage

Patented

A high quality instrument that is made for accuracy under modern plant conditions.

The design was developed from the original Crosby invention which included the use of two heavy Bourdon tube springs to operate the pointer.

Mounted in a strong and finely finished casing.

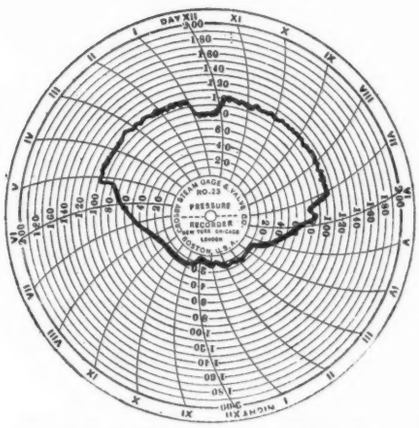
"The Crosby Gage" stamped on the dial is for your protection. Accept no gage without it.

Crosby Pressure Recorders

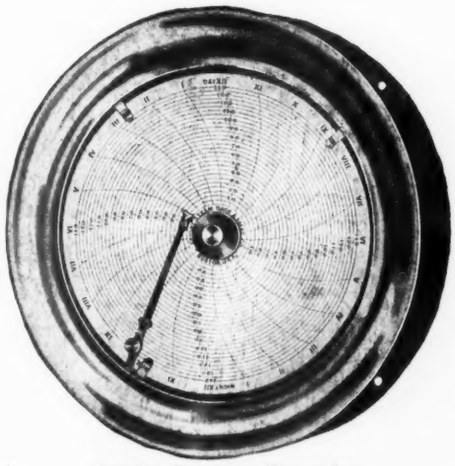
Patented

furnish accurate continuous records of the pressure during the entire day or week. Any abnormal rise or drop in pressure during this time is clearly shown. A study of the charts by the engineer will serve as a dependable guide in maintaining correct pressures in the different parts of the piping system.

If interested in either of these pressure instruments, be sure to write the nearest office.



Typical Daily Pressure Chart Record



Crosby Pressure Recorder

Crosby Steam Gage & Valve Company

Boston New York San Francisco Chicago London

STEAM SPECIALTIES CROSBY

20

STEAM SPECIALTIES CROSBY

"STEEL MIXTURE"

For 25 years "Steel Mixture" has occupied its high place in the estimation of engineers. The passing years only add to its fame. More than 8,000 power plants now standardize on "Steel Mixture."

Economy is more than ever before the watchword, and "Steel Mixture" is a great promotor of thrift. It is an extremely tough material, durable, and possesses extraordinary heat-resisting qualities.

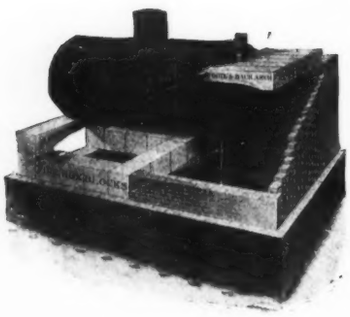
"Steel Mixture" will not shrink or form cracks for clinker lodgment. Clinkers cannot adhere readily to its smooth surface.

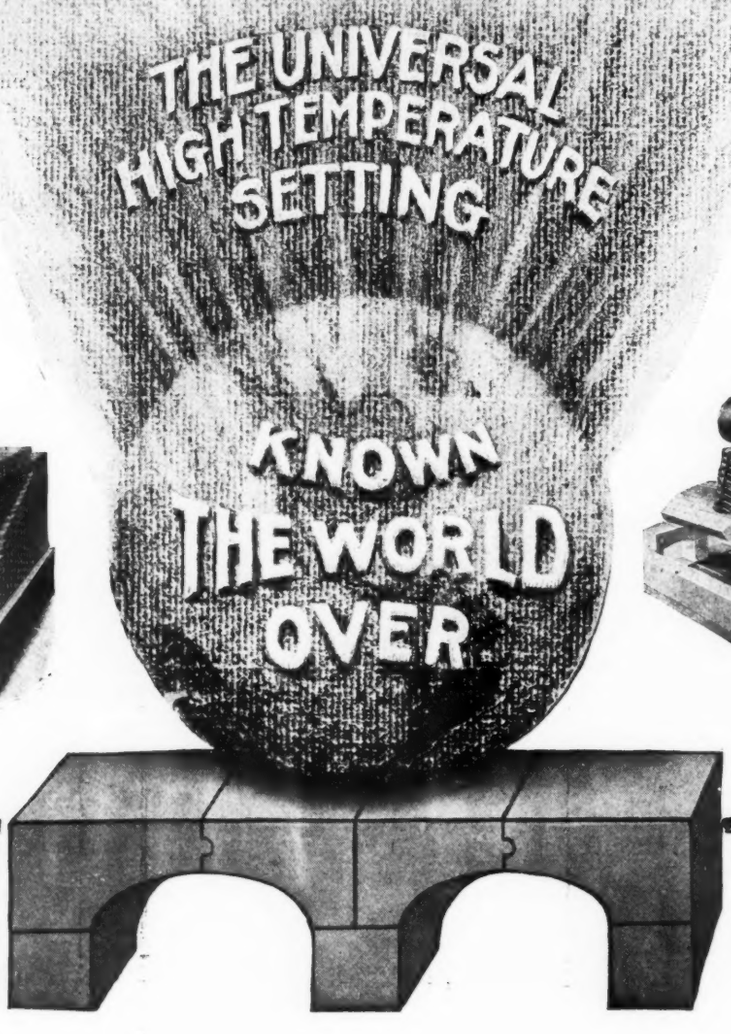
"Steel Mixture" lasts so long in service that repair bills and furnace shutdowns are practically unknown.

"Steel Mixture" is shipped ready to put in place. We fit each furnace setting in our own plant *before* shipment is made.

"Steel Mixture" is made for Furnace Linings, Boiler Door Arches, Back Arches, Furnace Roof Arches and Blow-off Pipe Protectors. For any type or make of boiler furnace.

Let us know your requirements and we will gladly submit estimates. You should have our Measurement Booklet No. 22. Write for your free copy.





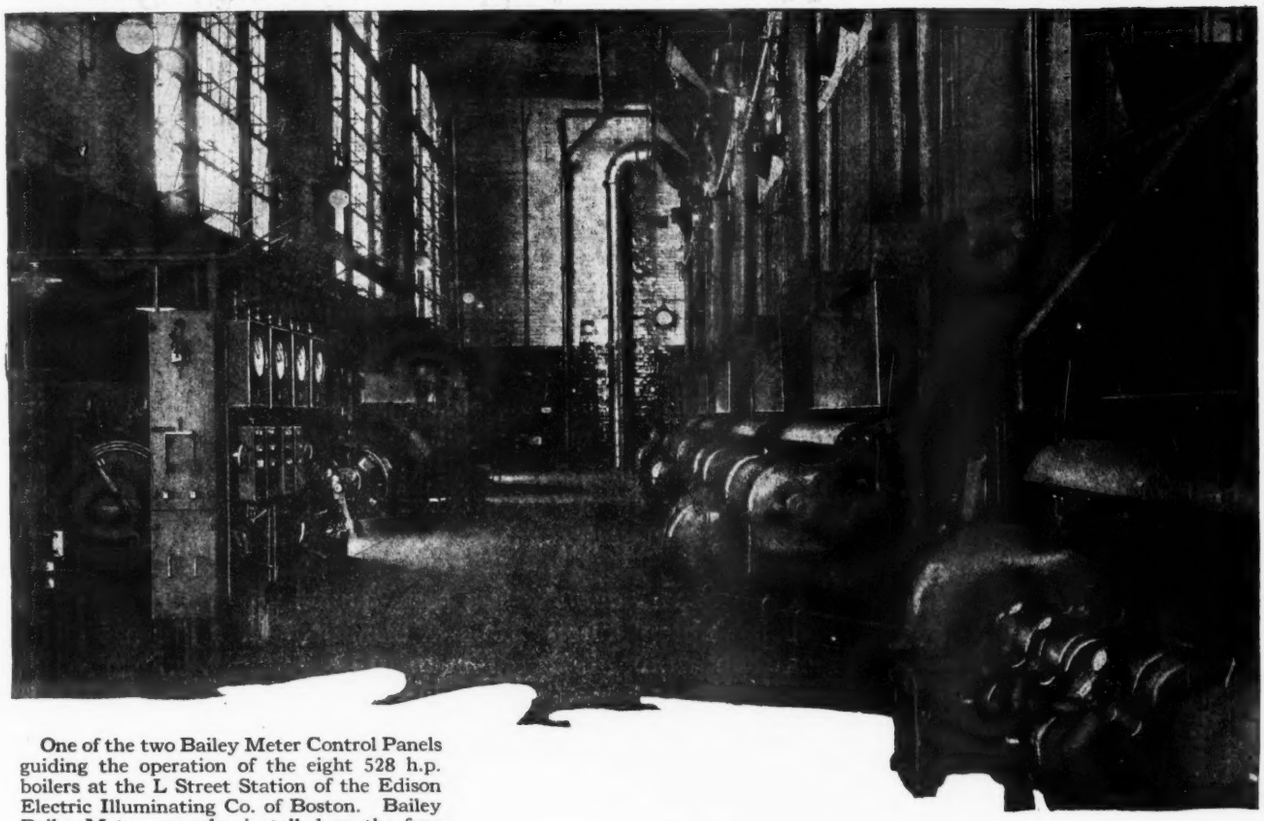
McLeod & Henry Company

Troy, New York

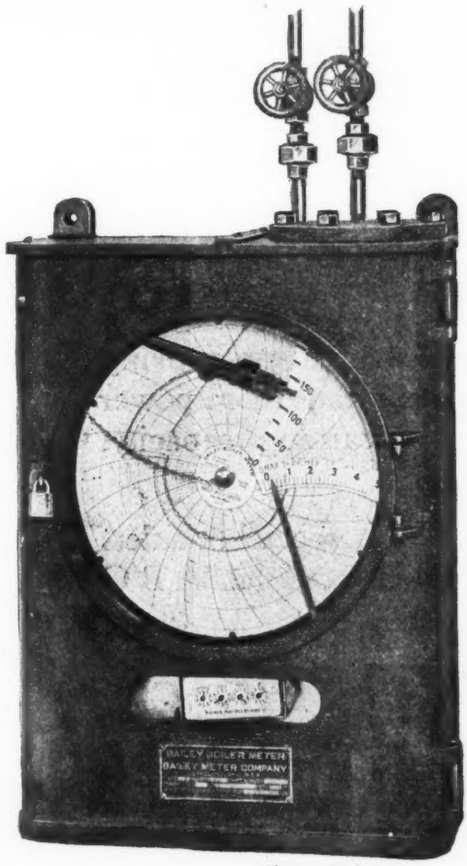
New York

Boston

Detroit



One of the two Bailey Meter Control Panels guiding the operation of the eight 528 h.p. boilers at the L Street Station of the Edison Electric Illuminating Co. of Boston. Bailey Boiler Meters are also installed on the four 1232 h.p. boilers at this plant.



Bailey Boiler Meter. Type 26, Class 56.

The Big Fellows Are Wise—

The big Central Stations were among the first to realize that interesting the firemen in their work would pay handsome dividends in the shape of coal saved.

BAILEY Boiler Meters

are installed where the firemen can see them all the time.

They record the true relation between the coal and air supply to the furnace and plainly show the men what adjustments to either are required to maintain high operating efficiency.

To the engineer the charts show the performance of the individual boilers and tell when a boiler requires cleaning or inspection for leaky tubes or broken baffles. He can check the work of the firemen at all times.

Do you wonder why Bailey Boiler Meters have saved coal in both the big stoker fired central stations and in hand fired factory plants?

Ask us for details. Write for Bulletin 41

Bailey Meter Company
2011 E. 46th St., Cleveland, Ohio

Your Truck Is Just As Efficient As Its Lubricant

The man who asks, "How efficient are my trucks?" had better ask *"How well lubricated are my trucks?"* For, after all, good lubrication is the basis of successful machine operation—the big reason for the efficiency, or lack of efficiency, of any production or transportation unit.

Big truck users throughout America are proving every day that Keystone Grease means more power to the motor truck—increased earning capacity, longer life and lower upkeep.

Write today for a free copy of our special booklets "More Power to the Motor Truck" and the "A B C of Automobile Lubrication."

KEYSTONE TRADE MARK Reg. U.S. Pat. Off. GREASE

KEYSTONE LUBRICATING CO.

New York
Boston
Pittsburgh
Chicago

Executive Office and Works
PHILADELPHIA, PA.
Established 1884

St. Louis
Denver
San Francisco
Minneapolis
Houston

Continental European Offices: Marseilles, France

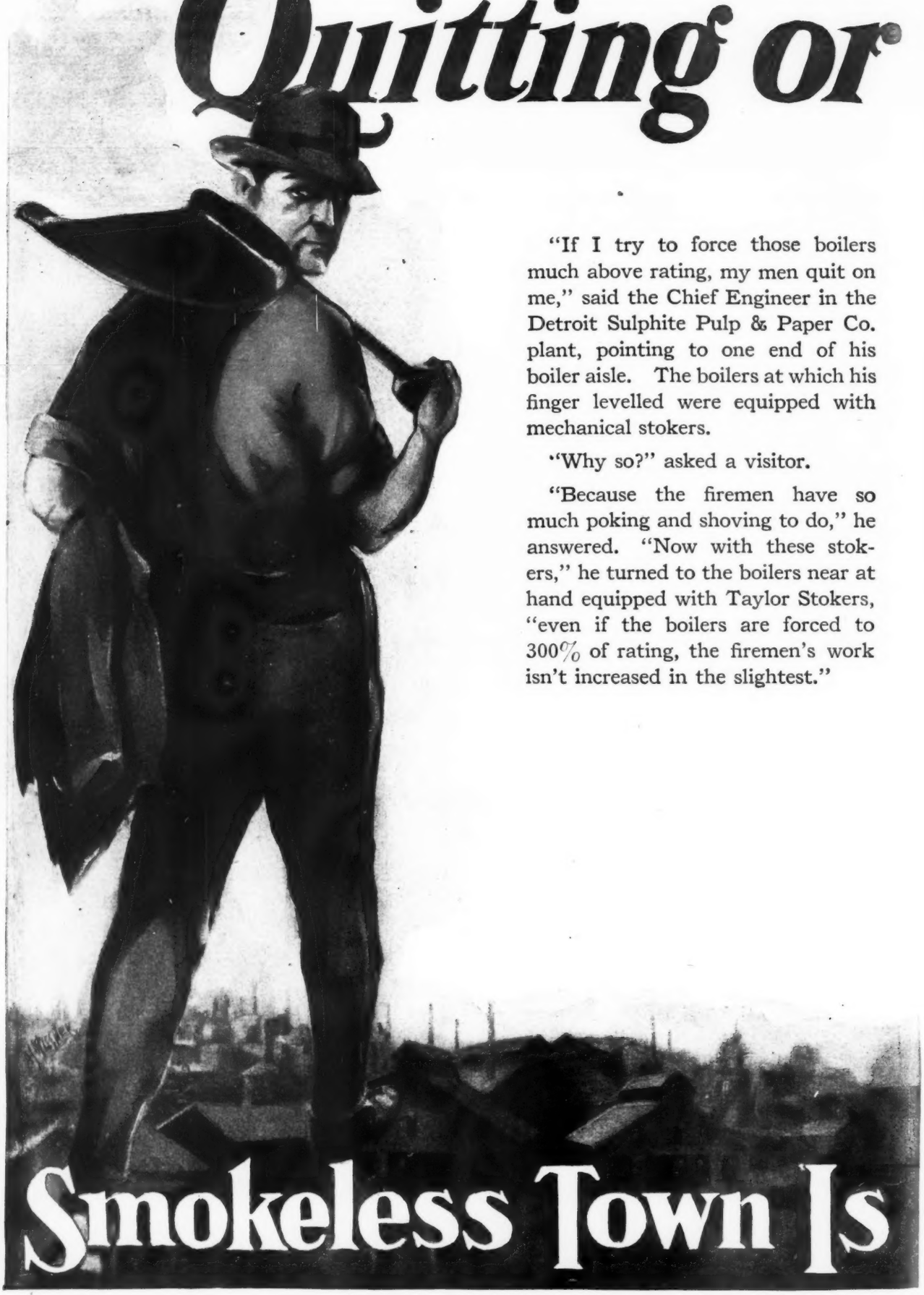
India: Calcutta, Bombay
Norway: Christiania
Italy: Turin
Denmark: Copenhagen
Japan: Tokio
Egypt: Cairo
Jamaica: Kingston

The Taylor Stoker

MORE THAN A STOKER—
a Complete System of Combustion

Continued on next three pages

Quitting or



"If I try to force those boilers much above rating, my men quit on me," said the Chief Engineer in the Detroit Sulphite Pulp & Paper Co. plant, pointing to one end of his boiler aisle. The boilers at which his finger levelled were equipped with mechanical stokers.

"Why so?" asked a visitor.

"Because the firemen have so much poking and shoving to do," he answered. "Now with these stokers," he turned to the boilers near at hand equipped with Taylor Stokers, "even if the boilers are forced to 300% of rating, the firemen's work isn't increased in the slightest."

Smokeless Town Is

Sticking-Which?

Operating men know that equipment with mechanical stokers is not necessarily a guarantee that the labor problem is solved. There are stokers and stokers. Some stokers require almost as much labor as hand-firing.

When the Taylor Stokers went into this Detroit plant, for instance, certain firemen who had been on the job with the other stokers persisted in throwing open the observation doors on the Taylor Stokers and poking and shoving the fire, thus exposing the tuyere plates which the Taylor System automatically keeps blanketed with green coal. These firemen thought that poking and barring was a necessary adjunct of mechanical stoking. "I thought I'd have to put padlocks on those observation doors," the Chief said. "But finally we persuaded the firemen that the Taylor Stokers are made to be let alone."

This plant consists of eight 258 h.p. units. Four of these are now fired by Taylor Stokers.

Because of the labor advantage which the Chief refers to, and because Taylor Stokers will operate the boilers at greater capacity on poor coal than the other stokers will operate them on good coal, the four remaining boilers will shortly be equipped with Taylor Stokers also.

The Taylor Stoker

really solves the labor problem. One man easily cares for from 5,000 to 10,000 h.p. equipped with Taylor Stokers, and has no strenuous job, either. It is a job calling on his intelligence instead of his muscle—a job that appeals to a man—a job he likes to stick to.

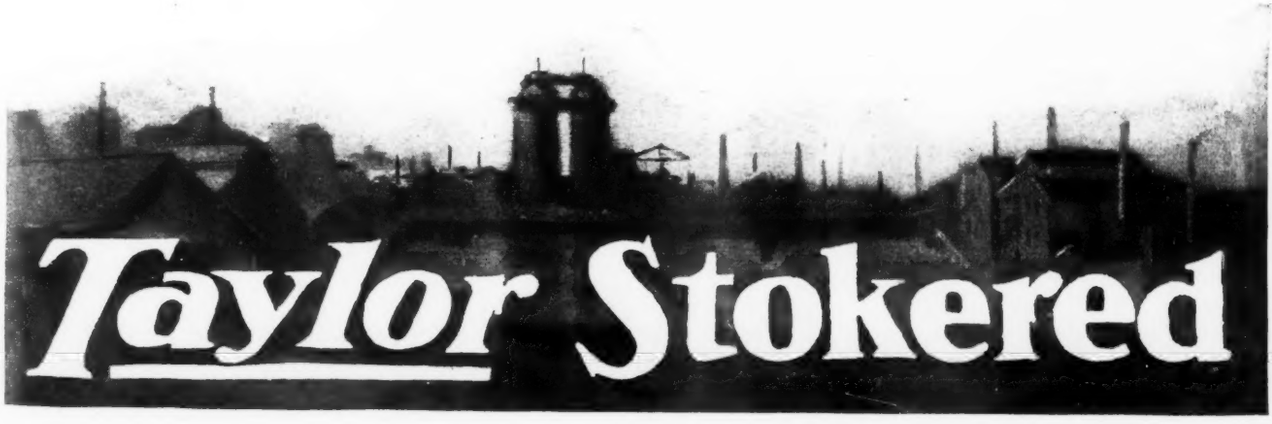
The Taylor Stoker solves the coal problem. It is first in coal-burning efficiency.

The Taylor Stoker solves the capacity problem, and the variable load problem. Ask the responsible men in any Taylor-Stokered plant what the Taylor has done in these respects. Ask them also their opinion of Taylor Stoker *service.*

Send today for the booklet, "Today's Problems and the Taylor Stoker."

American Engineering Co., Philadelphia, Pa.

The Taylor Stoker Co., Ltd., Toronto, Canada



The Taylor Stoker

These, too, are Taylor-Stokered

American Smelting & Refining Co.
Arlington Mills
Atlantic City Electric Co.
Atlantic Sugar Refineries, St. Johns, N. B.
Atlas Cement Co.
Baltimore Copper Smelting & Rolling Co.
Boston Elevated Railway Co.
J. G. Brill Co.
Brooklyn Edison Co.
Champion Fibre Co.
Chickasaw Shipbldg. Co.
Columbia Chemical Co.
Cuban American Sugar Co.
Cumberland Edison Co.
Everett Mills
Globe Soap Co.
John Hopkins University
Inland Steel Co.
Iowa Railway & Light Co.
Louisville Cement Co.
Luken Steel Co.
Michigan Alkali Co.
National Lead Co.
National Tube Co.
Oxford Paper Co.
Pennsylvania Shipbldg. Co.
Philadelphia Rubber Works
Pittsburgh Plate Glass Co.
Potomac Electric Power Co.
Ray Consolidated Copper Co.
Republic Iron & Steel Co.
Riverside & Dan River Cotton Co.
Standard Steel Car Co.
State, War & Navy Bldg.
Tennessee Coal, Iron & R. R. Co.
Union Bag & Paper Co.
United Illuminating Co.
U. S. Coal & Coke Co.
U. S. National Museum
U. S. Steel Corporation
Wardlow-Thomas Paper Co.
Wilmington & Phila. Traction Co.

American Engineering Company

Philadelphia, Pa.

Taylor Stoker Co., Ltd., Toronto, Canada

REG. U.S. PAT. OFF.
TRADE
JENKINS
MARK
Jenkins Bros

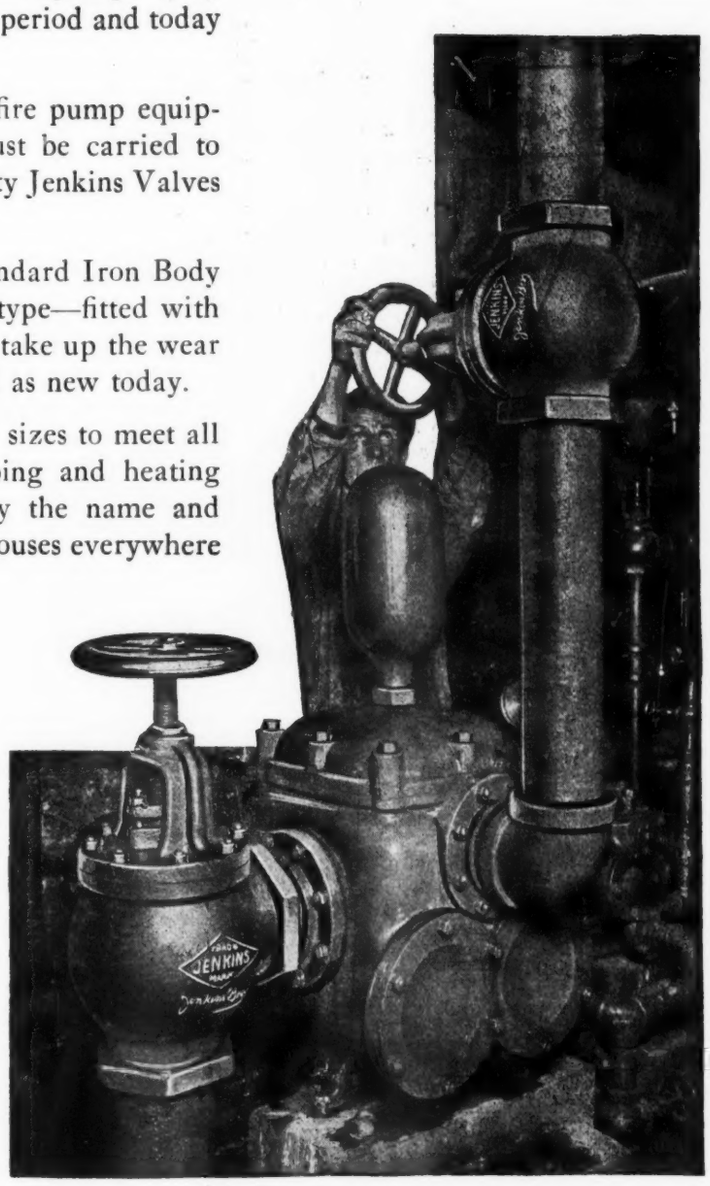
Over 32 years ago—

when the plant of the Hellwig Silk Dyeing Co., in Philadelphia was erected Jenkins Valves were installed on the intake and exhaust lines of the fire pump. They have seen service daily over the entire period and today are as dependable and active as ever.

Trouble-free, emergency-responding fire pump equipment is essential. Dependability must be carried to every point—for their known reliability Jenkins Valves were choosen.

The valves illustrated are Jenkins Standard Iron Body Valves, a 6-in. angle and 5-in. globe type—fitted with Jenkins renewable discs. These discs take up the wear and the valves are practically as good as new today.

Jenkins Valves are made in types and sizes to meet all requirements of power plant, plumbing and heating service. The genuine are known by the name and Jenkins "Diamond Mark." Supply houses everywhere can serve you.

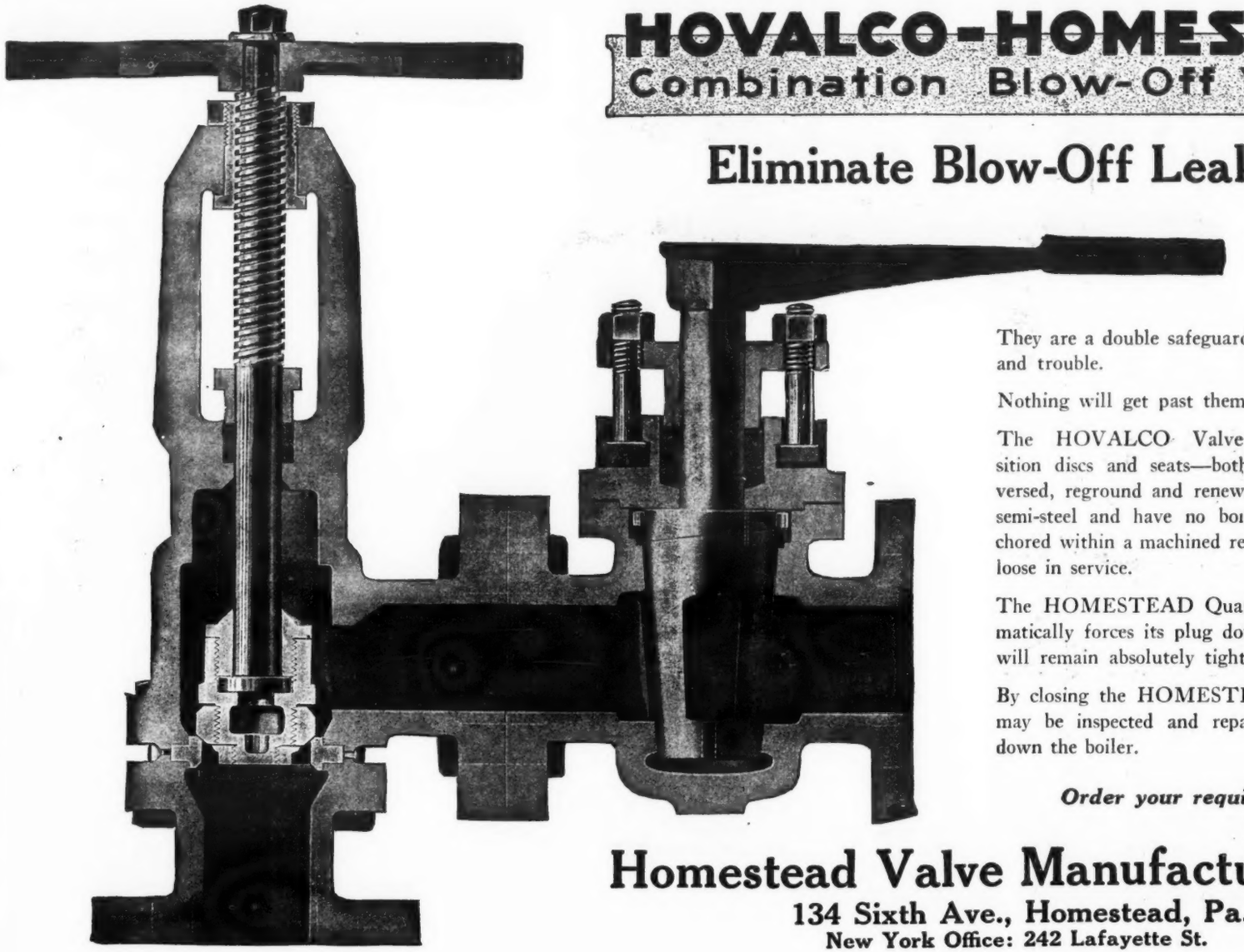


JENKINS BROS.

New York Philadelphia Montreal
St. Louis San Francisco London
Chicago Pittsburgh Havana
Boston Washington

2174-J

Jenkins Valves



HOVALCO-HOMESTEAD
Combination Blow-Off Valves

Eliminate Blow-Off Leakage

They are a double safeguard against wasteful leaks and trouble.

Nothing will get past them when closed.

The HOVALCO Valve has special composition discs and seats—both of which can be reversed, reground and renewed. The bodies are of semi-steel and have no bonnet. The seat is anchored within a machined recess and cannot become loose in service.

The HOMESTEAD Quarter Turn Valve automatically forces its plug downward in closing and will remain absolutely tight without adjustment.

By closing the HOMESTEAD the HOVALCO may be inspected and repaired, without shutting down the boiler.

Order your requirements now

Homestead Valve Manufacturing Co.

134 Sixth Ave., Homestead, Pa.

New York Office: 242 Lafayette St.

"She runs slack—without a slip"

Belts that are run tight to prevent slipping are working under a tension that overloads the bearings, shafting, engine, and the belts themselves with a dead drag of friction. They demand excess fuel and lubrication to get the desired transmission power, and constant attention to remedy the belt trouble that develops.

The strain of tight running stretches the belt and destroys its elasticity. Further, even if a belt is tightened until the bearings run hot the relief from slip can be only temporary. Each subsequent tightening puts the belt into worse condition.

This old manner of belt management has been replaced by

Cling-Surface

Belt Preservative

The New-Day Way for treating belts.

Cling-Surface stops belt slippage immediately—and permanently. It will allow you to run your belts slack, utilize the power formerly wasted and thus increase the output of your machines.

It will make and keep your belts (and ropes) mellow, flexible, water-proofed and durable. It makes them last longer, because it is a clean neutral preservative and lubricating food. It contains not a trace of rosin, *we guarantee that.*

We also guarantee that consistent systematic treatment with Cling-Surface will produce all these results in your belts and in your plant. To prove it we will send you a 50 lb. can absolutely free of charge. If within 60 days you are not **completely satisfied** with results you may return the remainder at our expense.

"Savac"—"Save a Cable" with a real preservative which stays put. Ask for details.

Clip and mail NOW.

(Name) .....

(Address) .....

Cling-Surface Co., 1049 Niagara Street, Buffalo, N. Y.

Gentlemen:

Send me at once the items checked.

☐ 25 lb. can of Cling-Surface

☐ Booklet N-13

☐ 50 lb. can of Cling-Surface

☐ Place my name on mailing list

☐ Information about SAVAC.

P.6-29-20

Cling-Surface Company

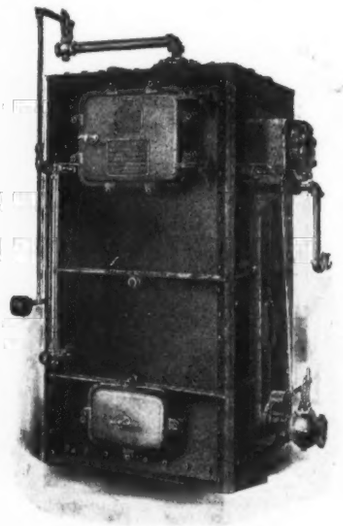
1049 Niagara Street, Buffalo, N. Y.

There's a Webster Heater

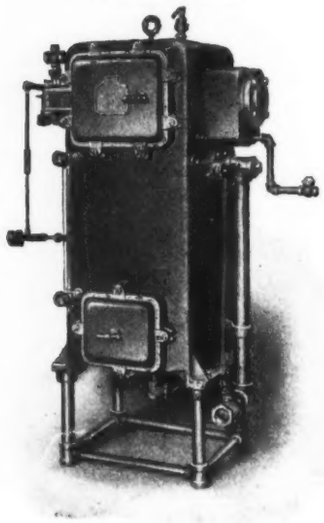
When properly designed and adapted to the particular conditions in a given plant, an open feed water heater will heat the water to within 2 to 5 degrees of the temperature of the exhaust steam, saving about 1 per cent of the fuel for every eleven degrees the water is raised in temperature and purifying the water as well.

In our thirty-two years of leadership as the pioneer builders of the "no thoroughfare" type of open feed-water heaters we have developed the experience and knowledge necessary to assure greatest benefits under any required plant conditions.

From the many special types and designs which more than 6000 installations have proven to be highly efficient, the following are found to be particularly suitable for most power plant, industrial and heating system requirements.



Type EB Heater



Type EF Heater

Which class fits your plant?

Type EB is the standard rectangular pattern for capacity of 300 to 12,000 h.p., combining with the heating function an efficient oil separator, filter and liberal storage capacity. For use in industries where there are intermittent demands for large quantities of hot water, this heater is modified by addition of much larger storage capacity at the bottom.

Type EBH is exactly the same as the EB, except that the plates are thickened and strengthened for higher back pressures—as, for instance, in a paper mill using higher pressure exhaust steam for drying purposes.

Twin heater units connected to a common exhaust main are recommended for large plants and for those operated continuously. This arrangement avoids piping and control complications and permits one heater to be taken out of service for cleaning while the other remains in use. The twin arrangement also forms an easy method of increasing capacity by the addition of the second heater after the first has become too small for plant needs.

Warren Webster & Company

for every type of plant—

Type EF is for smaller capacities, 50 to 350 h.p., and is similar to Type EB, except that the shell is a one-piece casting and is supported by a framework made from pipe and fittings. Type EG is the same heater modified for power service only.

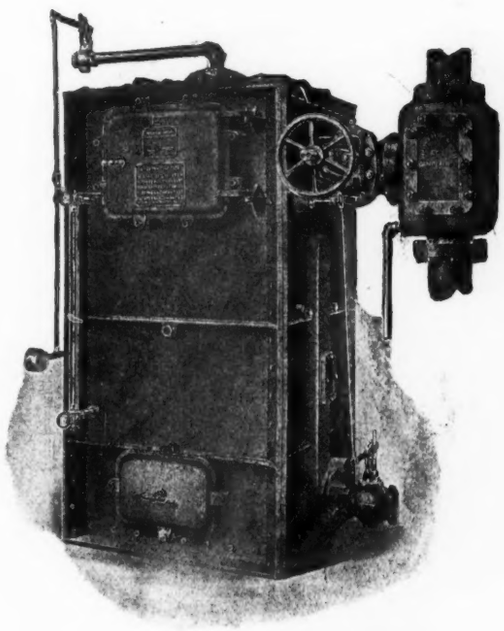
Type ED is of horizontal cylindrical form, for 500 to 15,000 h.p. It contains all the essential features of the rectangular types, but has extra large storage capacity, for receiving returns from heating or drying system, hot well, etc., and is particularly desirable also where there is less headroom than required for a rectangular heater.

The preference cut-out type is a further development of our EB, ED, EF and EG types through the substitution of an extra large three-way oil separator, by means of which all the exhaust steam, not merely that going to the heater, is purified from oil. The heater automatically takes what steam it needs, while the rest passes to heating system or to atmosphere. A cut-out valve between the oil separator and the heater permits isolation of the heater for cleaning, etc., without disturbing the flow of steam through the separator. This type is particularly desirable where part of the engine exhaust goes to the heating system.

The Webster engineering staff is always ready to co-operate with reliable advice in assuring the selection of an exactly suitable feed-water heater.

This service is freely available through our thirty branch offices in all parts of the country.

Type ED Heater



Preference Cut-Out Type Heater

Exact figures of savings which are effected in year-after-year use of Webster Feed Water Heaters and the details of construction which assure low maintenance cost and high efficiency are given in our two bulletins 100-1 and 102. They include information of interest and practical advantage to every power plant engineer and point the way to material savings in fuel. *Send for both.*

Executive Offices and Works — Camden, N. J.

Branch offices and representatives in all large cities

45

FLAT SUSPENDED ARCHES DET

THE Willard Storage Battery is known throughout the world. The announcement then that The Willard Storage Battery Company has standardized on DETRICK FLAT SUSPENDED ARCHES will not come as a surprise to more than 4,000 other nationally known manufacturers who are using them.

Back of any manufactured product that is nationally recognized there is a modern plant.

In the heart of that modern plant you will usually find Detrick installations, because they have been tried and proven. Their faith in the Detrick Arch is your assurance that Detrick is the safe arch. You need the Detrick Catalog.

Get in touch with any of these Detrick Sales Offices. They will assist you in solving your Arch problems.

M. H. DETRICK COMPANY

549 W. Washington St., Chicago

n the Heart of the Power Plant of the Famous WILLARD Storage Battery Factory are

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Cleveland, Ohio	515 National City Bldg.	San Francisco, Calif.	507 New Call Bldg.
Chicago, Ill.	901 Marquette Bldg.	Atlanta, Ga.	829 Trust Co. of Georgia Bldg.
Milwaukee, Wis.	620 Wells Bldg.	Detroit, Mich.	410 Moffat Bldg.
Boston, Mass.	141 Milk St.	Indianapolis, Ind.	305 Merchants Bank Bldg.
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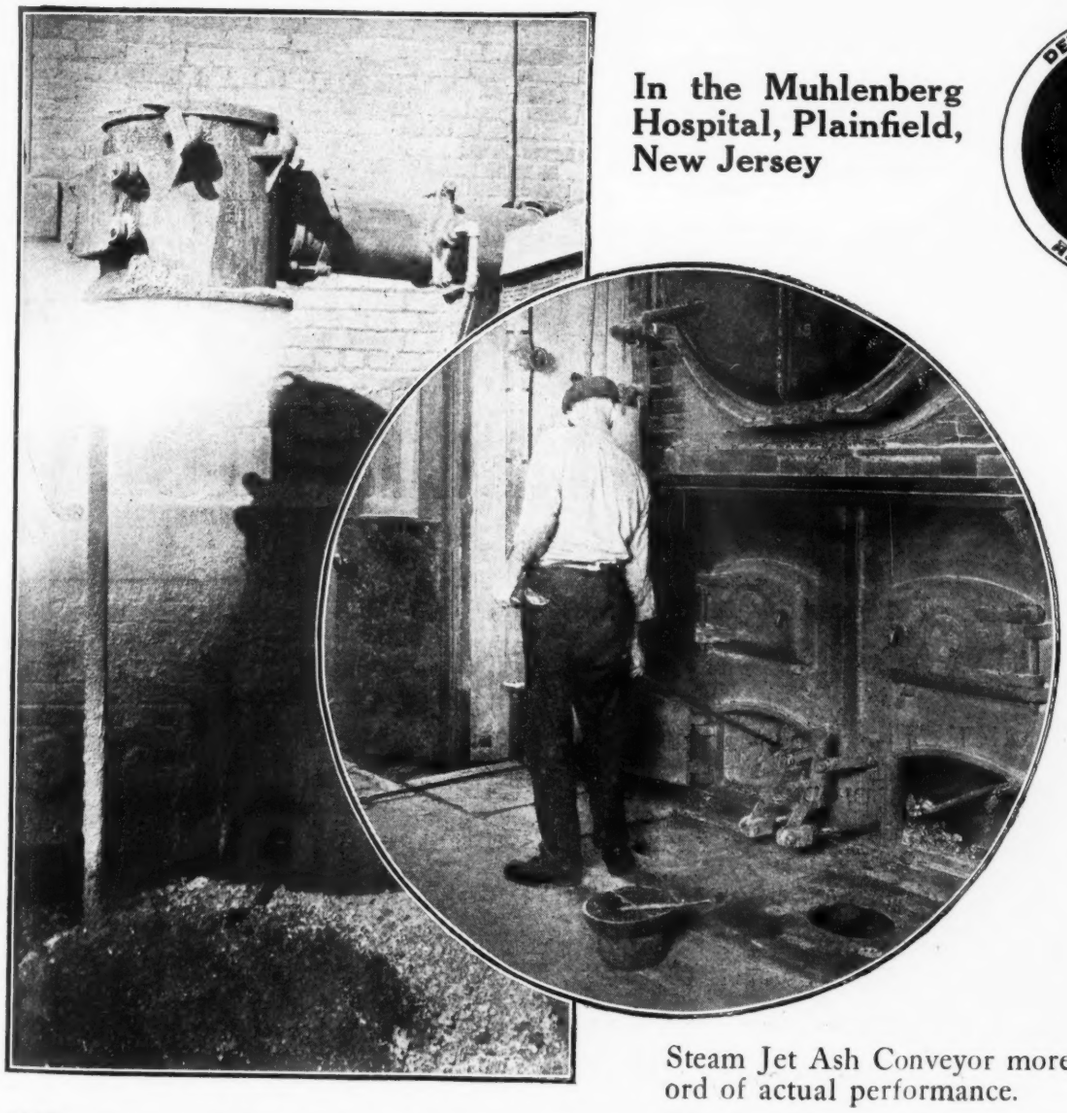
TRICK DETRICK-HAGAN ASH CONVEYORS



In the Muhlenberg Hospital, Plainfield, New Jersey

Working Most Satisfactorily

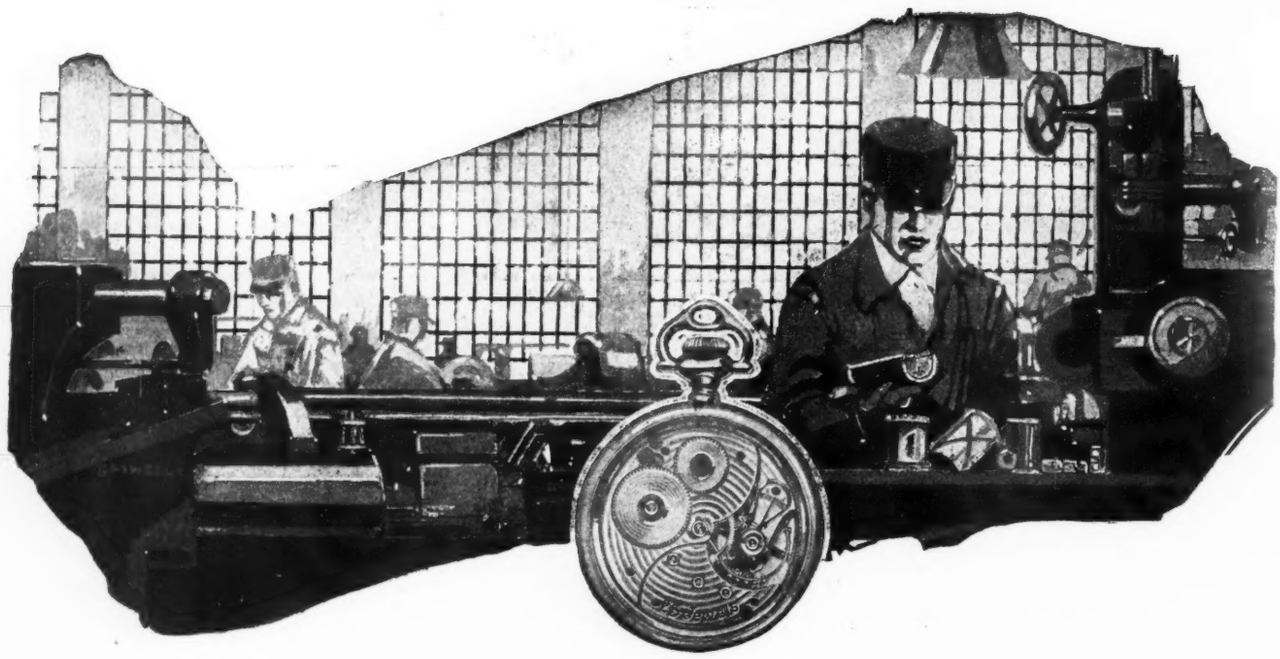
Mr. Smith, Superintendent of the Muhlenberg Hospital in Plainfield, N. J., writes:

"Our ash conveyor is working most satisfactorily in every respect, the wearing back showing hardly anything to indicate that it had been used, although this apparatus has been in service constantly since last Fall."

We can think of nothing we could say that would show the worth of the Detrick-Hagan Steam Jet Ash Conveyor more than this record of actual performance.

Mr. Smith's letter is one of many in our files expressing this same satisfaction.

One reason for this widespread endorsement, in addition to the correctness in design of the conveyor, is the ability of the Detrick-Hagan engineers to adapt their product to individual conditions. Experience with hundreds of installations make them of unusual value to the man with an ash disposal problem. They are at all times at the service of anyone interested in such equipment. For quick action, write the nearest office. See opposite page.



23-Jewel Machinery

The mark of a good watch is its jewels, the mark of a good machine its bearings.

PROMET, The Heat-Treated Bearing Metal, possesses unequalled bearing properties combined with unequalled lubricating properties. In addition to these it has other unique qualities which, in themselves, make PROMET essential in every machine in every plant.

If you are interested in a metal which has broken all records for bearing service in every kind of machinery, write TODAY for the PROMET book, "The Restoration of a Lost Art."

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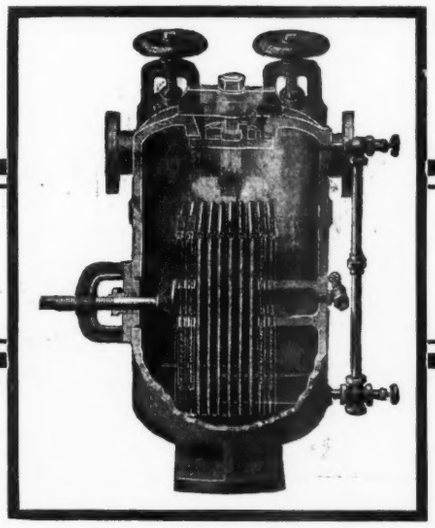


MULTI-SCREEN

Feed Water Filter and Grease Extractor

EVERY ENGINEER KNOWS there is oil in the hot return water —and he also knows that it will gum up the boiler's heating surface unless it is removed from the water *before* it enters the boiler.

If oil is permitted to enter the boiler along with the feed water—boiler efficiency will not only be materially decreased, but sooner or later costly repairs and shut-downs will become necessary.

The REILLY will remove ALL oil from the water and insure against such wasteful expenditure.

Money is too valuable to deliberately waste, even the smallest fraction of one per cent. Every measure of precaution should be taken against waste of ANY kind. The filtering medium of the REILLY is terry cloth mounted on specially designed wire screens so arranged that every particle of water passes through a single thickness of cloth only.

As the area of the filtering surface is 500 times the area of the water inlet pipe, the resulting velocity of filtration through the cloth is slow and efficient and freedom from oil in the boilers is assured.

Write for Bulletin 610.

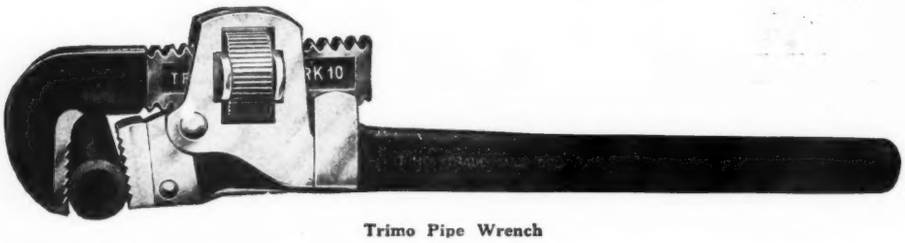
The Griscom-Russell Co.

2116 West Street Building, New York

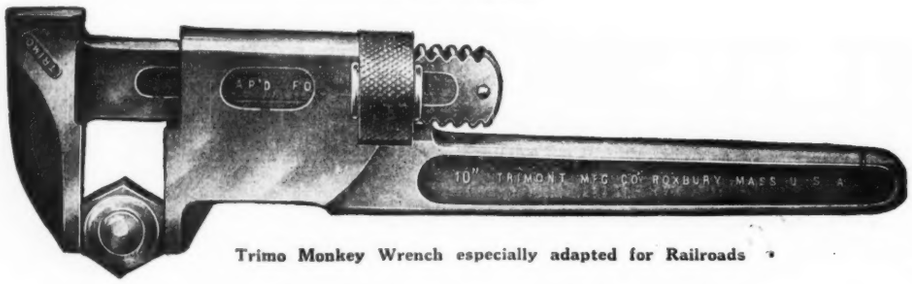
Boston *Pittsburgh* *Philadelphia* *San Francisco* *Chicago*

"Keeps the Oil Out of Boilers"

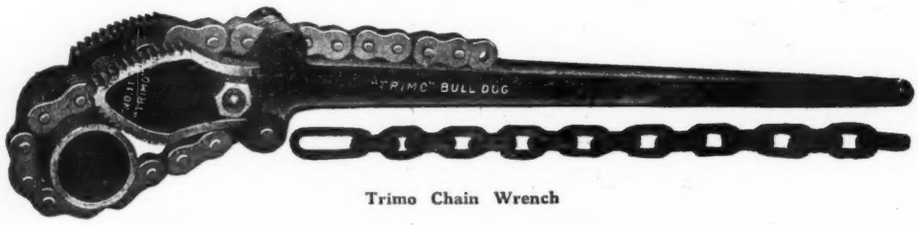
TRIMO



Trimo Pipe Wrench



Trimo Monkey Wrench especially adapted for Railroads



Trimo Chain Wrench

The Word Trimo

stands for good tools made by the Trimont Mfg. Co., which are the following:

The Trimo Pipe Wrench
The Trimo Chain Pipe Wrench
The Trimo Monkey Wrench
The Trimo Pipe Cutter (Hand)

The four good points that make **Trimo Pipe Wrenches** superior are the **Spiral Spring** always in place—**Steel Frames** that will not break—**Nut Guards** that protect adjustment nut—and the **Inserted Jaw** in handle that can be replaced when worn—**Save Money** and buy Trimo goods, made by

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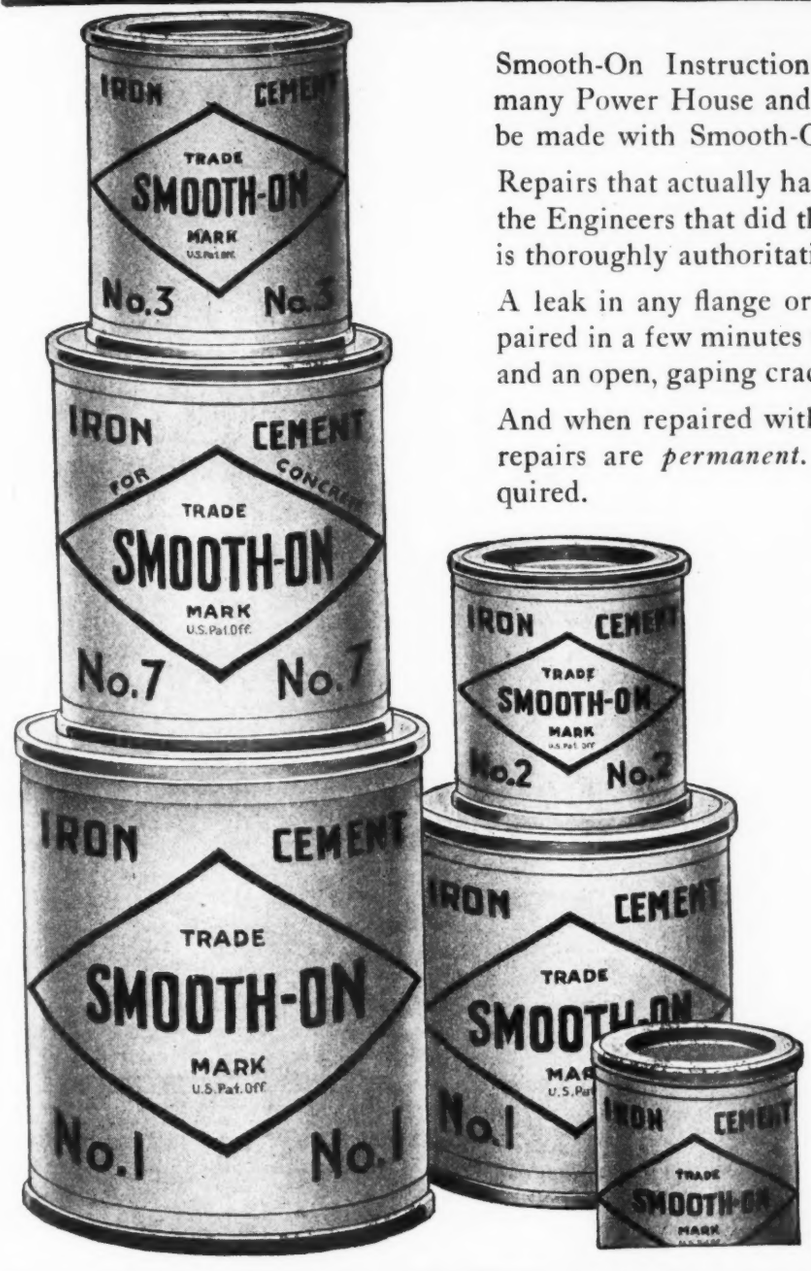

Smooth-On Instruction Book No. 16 describes the many Power House and Boiler Room repairs that can be made with Smooth-On Iron Cements.

Repairs that actually have been made are described by the Engineers that did the work, consequently the book is thoroughly authoritative.

A leak in any flange or screw thread joint can be repaired in a few minutes with Smooth-On Iron Cement, and an open, gaping crack is almost as easily fixed.

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Many of the repairs that are described might occur in your Engine Room any day.

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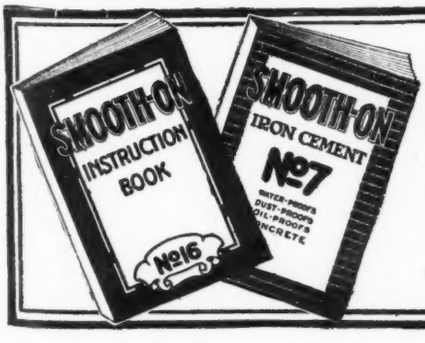

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The steam is immediately and continuously brought into contact with the cold air. The condensate falls through copper pipes back to the return. There are no ledges or pockets to hold moisture or retard condensation.

The solid construction and lasting qualities of the BURT body are solid reasons for everlasting confidence when ordering Exhaust Heads in specifying—"BURT."

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HOW DO YOU SPOT B. T. U. LEAKS?

What percentage of the heat of the coal do you get into the steam; that is, what part of the usable heat value of the coal is doing work in converting water into steam—whether your coal is good or poor?

B.t.u.'s, like pigs, have a perverse way of being able to find every way except where they are wanted to go.

A large percentage may drop through the grate into the ashpit, in the form of unconsumed carbon.

Another contingent goes to heat up the air that leaks through cracks and porosities in the boiler setting.

A large percentage carrom off from the scale and soot on the tubes and stay with the crowd that escapes in the flue gases. Still others jump the fence entirely, and depart as radiation.

Are you sure that you get all the B.t.u.'s you contract for—that they are actually in the coal when you buy it?—that they are capable of being gotten out by your equipment? And are your boiler room men keen and watchful about rounding up all B.t.u.'s possible?

COCHRANE METERING HEATER

A Cochrane Metering Heater (Combined Open Feed Water Heater and Hot Water Meter) or a Cochrane Independent Meter will tell you all this.

The Cochrane Metering Heater is also efficient in garnering B.t.u.'s. By heating all the boiler feed up to 210° F. it can save 12 to 15% on the coal consumption.

The Cochrane Metering Heater and the Cochrane Independent Meter when installed according to our patents, meter water at 212° F., or hotter, according to the back pressure, without escape of vapor or loss of B.t.u.'s, unaffected by the intermittent action of reciprocating pumps.

Would you like to confer with one of our B.t.u. experts, a man who is adept at increasing the crop of B.t.u.'s and decreasing the coal bill? His services are at your disposal, by correspondence or personal interview. Fill out coupon for our book on **"Hot Water Meters and Their Practical Application."**

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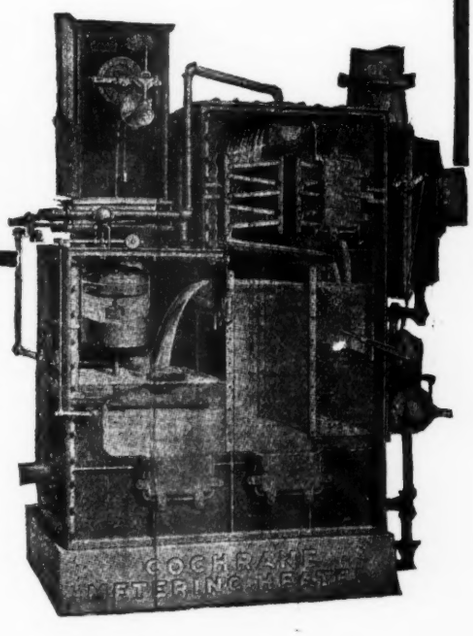

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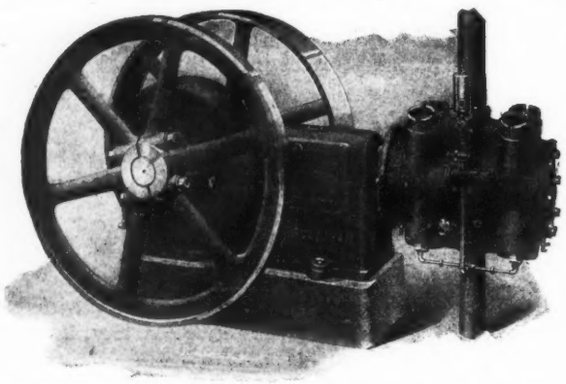
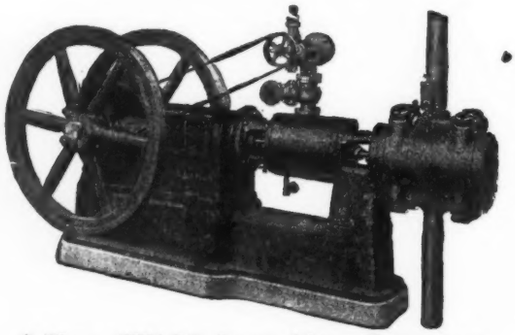
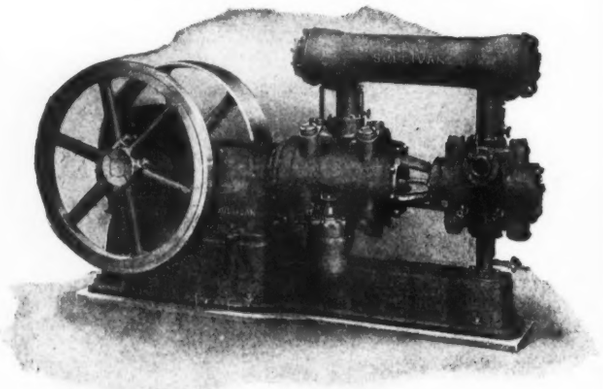
AIR COMPRESSOR RELIABILITY



Sullivan "WG6," Belted Compressor, 50-450 cu.ft. Bulletin 775-R



Sullivan "WA6," Steam-driven Compressor, 120-450 cu. ft. Bulletin 775-P



Sullivan "WH6," Two-Stage Belted Compressor. Bulletin 775-R

Air Reliability

is the important thing for you, whether you use 100 feet of air power per minute, or 10,000.

In buying compressors you want—not a "cheap" machine, but one that you can depend on to run right and to run all the time—with greatest efficiency, with least power and attendance. These qualities are found to an unusual degree in these smaller

Sullivan Air Compressors

Splash lubrication, "Wafer," plate type inlet and outlet valves, water jackets on cylinders and heads, inlet valve unloading device, liberal area of bearing surfaces, high standards in materials and construction—are features of Sullivan small air compressors that secure to their owners steady, reliable, efficient air power service, year in and year out.

The types shown here can be shipped from stock in a number of convenient sizes.

Ask for prices.

Sullivan Machinery Company

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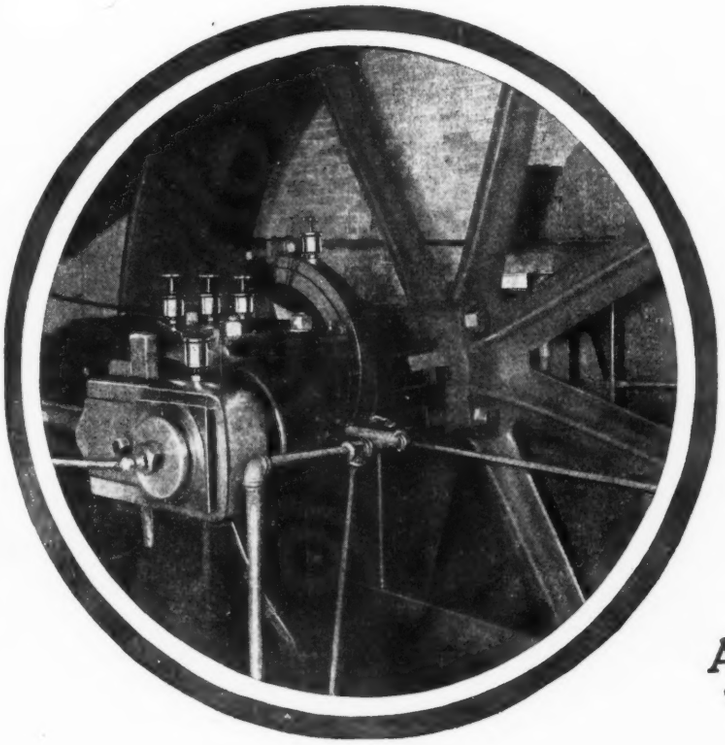
Keep All Bearings Running Cool

To have your engines, motors, pumps, generators, compressors, line shafting and all other special machines in your plant give efficient service, it is very necessary that all bearings run as cool as possible. A hot running bearing retards machine operation and increases friction load. There is always a chance of a hot bearing becoming seized and a seized bearing means a shut-down of machine or plant. To secure cool running bearings, see that they are well lubricated and a good lubricant used at all times.

ALBANY GREASE

has been used by engineers for more than 50 years for the lubrication of all kinds and sizes of bearings. Albany Grease is a pure tallow compound possessing high **lubricating qualities. It can be used successfully** in both the spindle, compression and absorption type of grease cup or bearing box. Albany Grease is made in seven different consistencies to meet varied bearing conditions. When the bearings run cool use Albany Grease No. 0 or No. 1. When the bearings run warm, use Albany Grease No. 2 or No. 3. For hot running bearings use Albany Grease Nos. X, XX or XXX. *We will gladly send samples without cost to you for trial.*



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708-10 Washington Street, New York
ESTABLISHED 1868

How do you buy a steam trap?

DO you look for simple, sturdy construction? Sure you do—the simpler the better—because that means fewer, easier repairs, if any.

Do you look for steady, reliable, uncomplicated operation? Of course—if it doesn't work you don't want it.

Do you look for a good record of results accomplished for other users? Certainly—you want a trap with a good reputation—one in which others feel confidence.

All right. Now here's the simplest steam trap made—and unequaled for rugged strength. It operates continuously and faithfully—without any fussy mechanism to get out of order. And thousands in satisfactory service bear witness to its good repute.

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The Johns-Manville Steam Trap—

How it works

It's a hollow copper ball that does the work. As water flows into the trap, the ball rolls up, exposing the outlet, and water is discharged. Any air that may be present is also drawn off. But when the water level falls, the ball rolls down with it and steam cannot pass the trap.

1/16"=1/8" and more

NOT true?

Yes, it's an absolute fact when you compare ordinary rubber sheet packing with Seigelite.

Suppose you've made up a joint with sixteenth inch flange to flange distance. What thickness rubber sheet did you use? Eighth inch, of course, and squeezed it down to a sixteenth.

For the same job you could use sixteenth inch Seigelite and have a better, tighter joint in the bargain. You'd have a gasket that wouldn't rip or squeeze out—that would far surpass rubber on water service—that could be used against gasoline, benzene and other solvents where rubber or rubber substitutes would absolutely fail.

Give these facts a thought the next time you start to order rubber sheet—for water, oil or gasoline service—and change it to Seigelite, the thinner packing for better service.

Seigelite is dense but resilient before it is squeezed between flanges.

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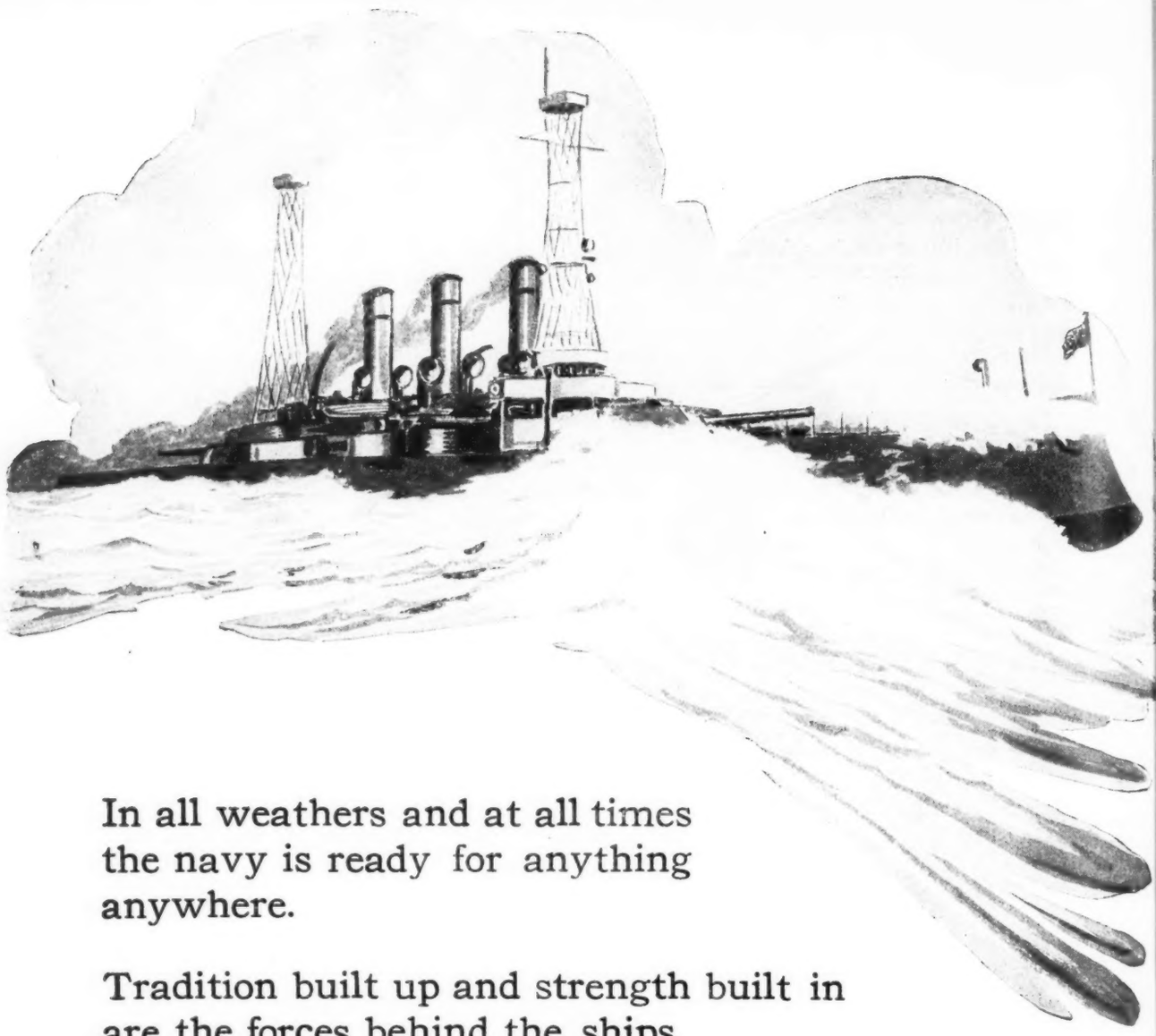
SAVING MATERIALS

Other Johns-Manville Power Plant Materials:—Asbestos and Magnesia Pipe and Boiler Insulations, to reduce radiation and heat loss from uninsulated heated surfaces in power plants, public institutions, private residences, etc.; Packings for engines, pump and valve rods and pipe joints, to prevent steam leakage and power loss; Steam Traps to collect condensation without leakage of steam; Refractory Cements to lengthen the life of boiler settings and prevent setting leakage; and many other power plant maintenance materials.



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Build "Continuous Service" Into Your Own Plant

Your Uncle Sam permits the use of steel flanges and fittings ONLY in his ships,

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Power Dept.

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"Steel Exclusively" to stand the shocks of wind and wave

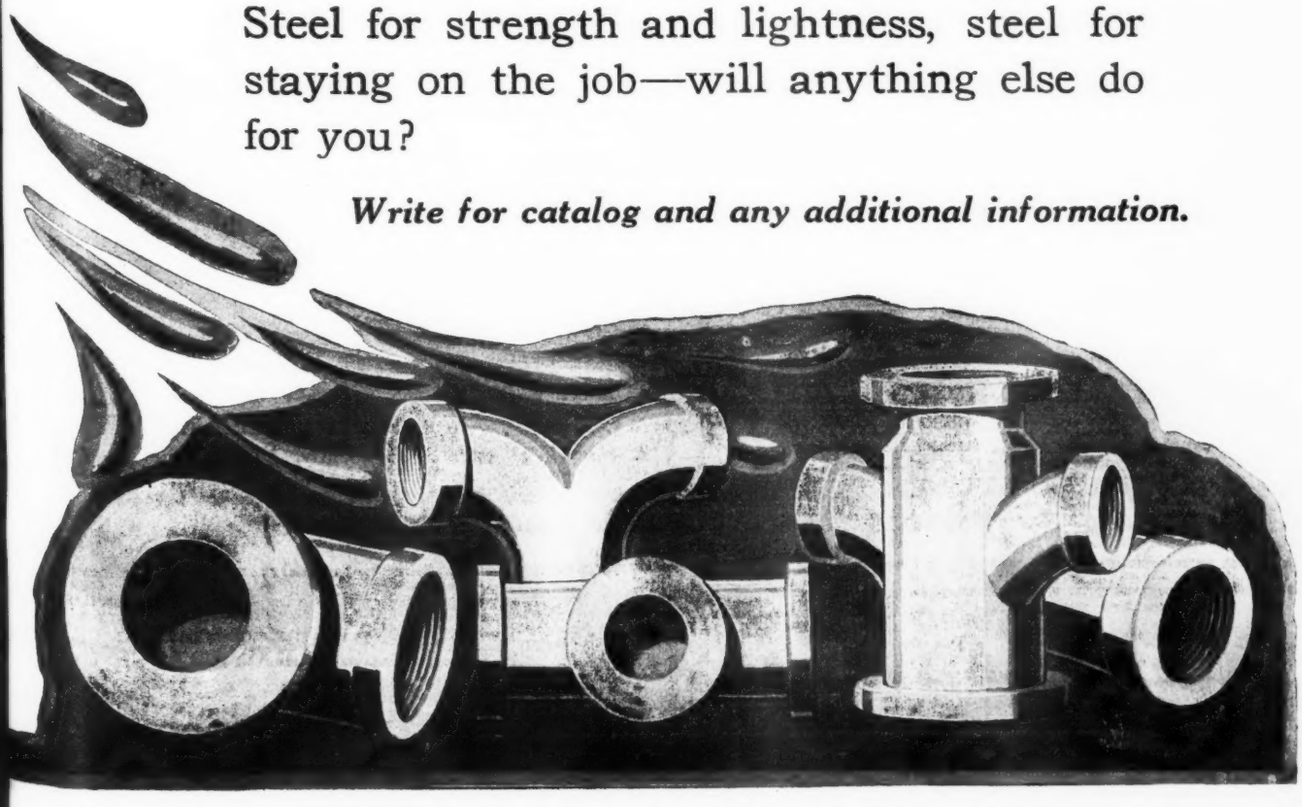
because there must be no break-downs in the navy service.

Reading Open Hearth Steel Flanges and Fittings

will prevent break-downs in your service and insure you against the high cost of idle wheels.

Steel for strength and lightness, steel for staying on the job—will anything else do for you?

Write for catalog and any additional information.



There's No Substitute For Quality

That's why there's no substitute for Genuine EUREKA; the Packing that gives and takes to all rod conditions and relieves the Engineer of his Packing burden—EUREKA has been doing that for 35 years (for pressures under 125 lbs.). Get EUREKA from your dealer or direct from us.

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76-77 Murray Street, New York City

Which?

The Old Soft Rubber Valves For Your Plant OR

Rub-Steel Valves

If you are running your plant by obsolete methods; satisfied with make-shifts and second best equipment; content to lose out in the march of progress, the old soft rubber valve is good enough.

Voorhees Rub-Steel Valve is the new way, the best way of obtaining real valve service. It cannot soften, dish or blow through the ports. The rigid "backbone" of steel keeps it strong under all temperatures and pressures. The rubber seating surface gives it the necessary resiliency.

Ask for free trial valve.

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Save your oil—save your engine—save your machinery and save your money by writing *today* for our 200-page catalogue.

It Contains Over 400 Illustrations and Practical Information on the Subject of Lubrication

We are the only concern in the United States that manufactures oil filters, oiling systems, telescopic oilers and oiling devices exclusively.

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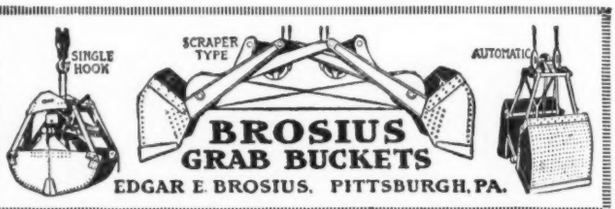

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Also Wheeler Condensers—all kinds—all sizes; Atmospheric Relief Valves; Centrifugal Pumps for all purposes; Cooling Towers, natural or forced draft; Evaporators, single or multiple effect; Seamless Brass and Copper Tubes for condensers, evaporators, rebollers, etc.

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The Brown Hoisting Machinery Company
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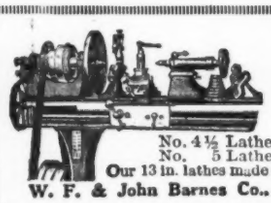

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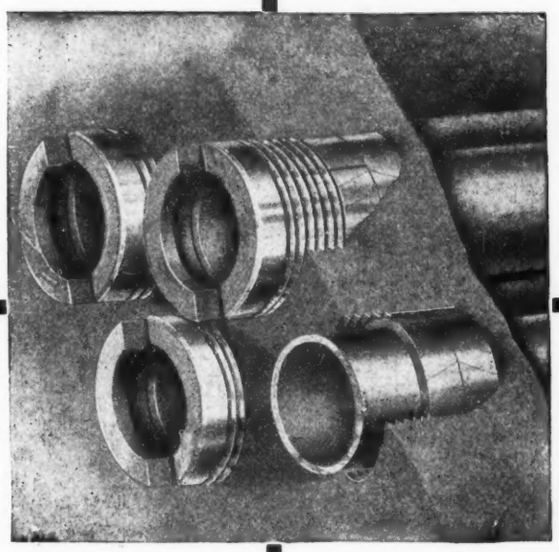

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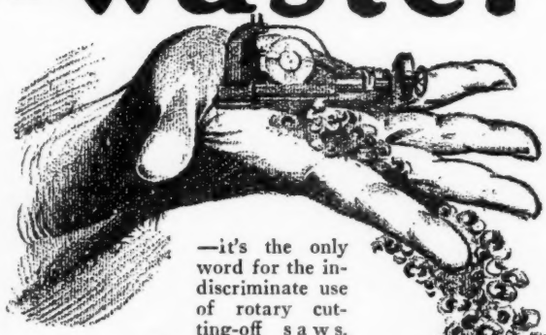

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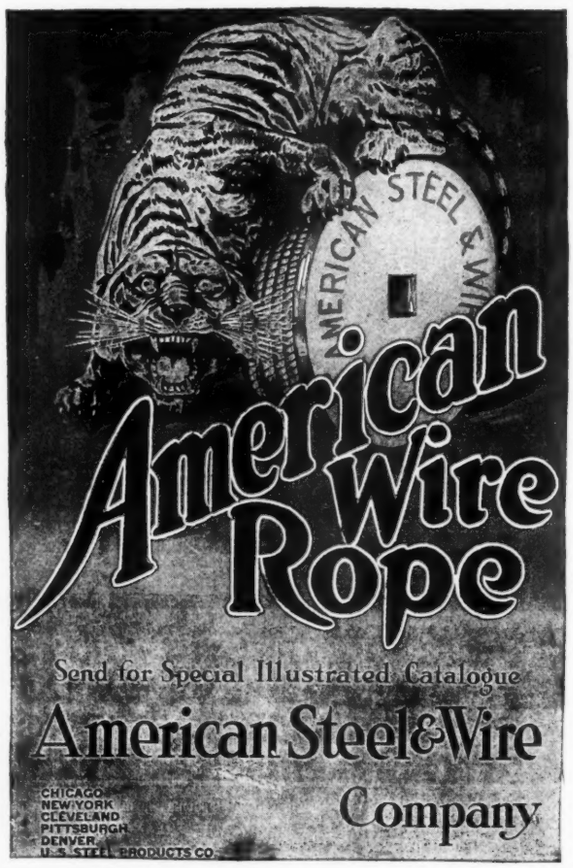

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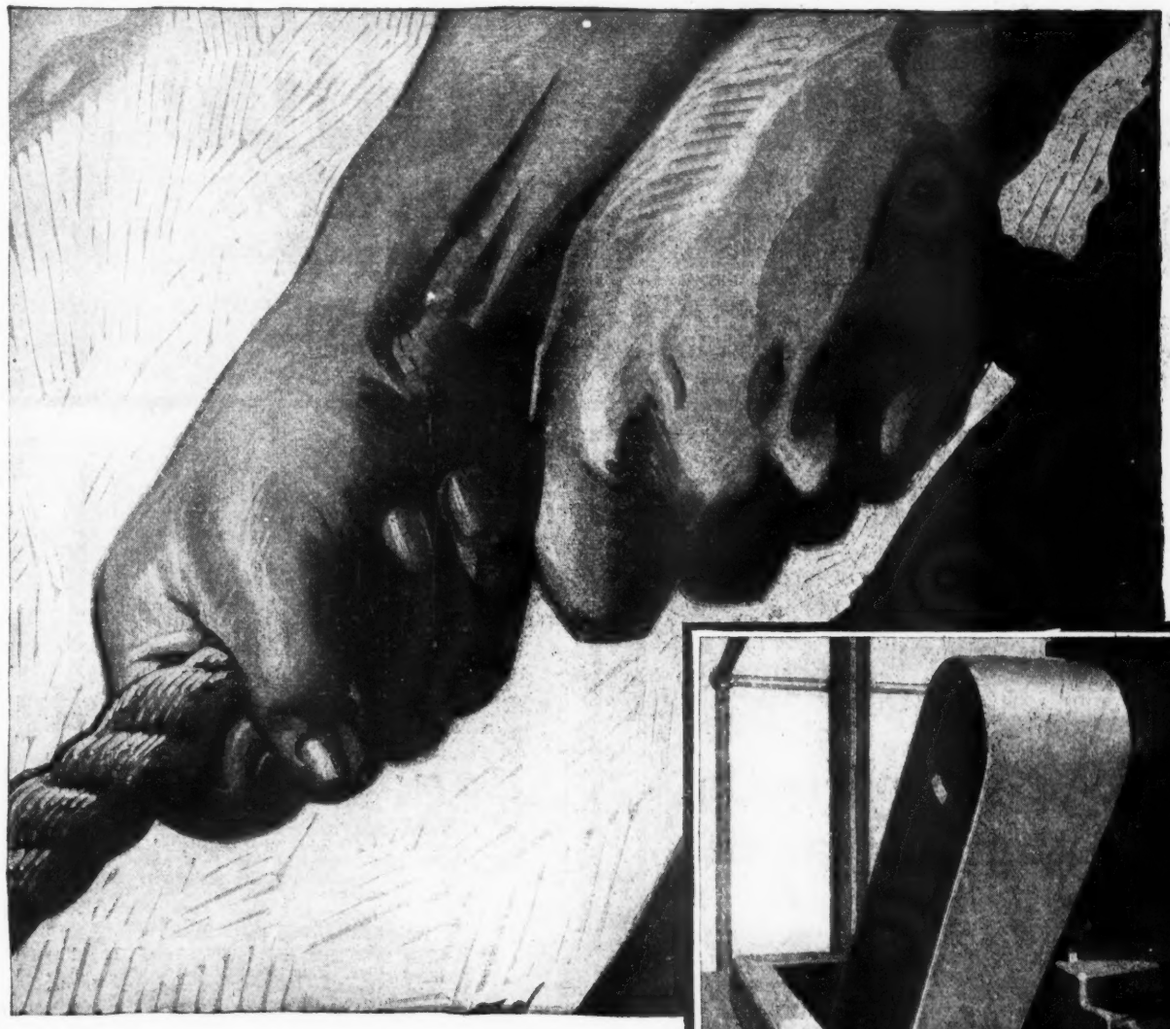

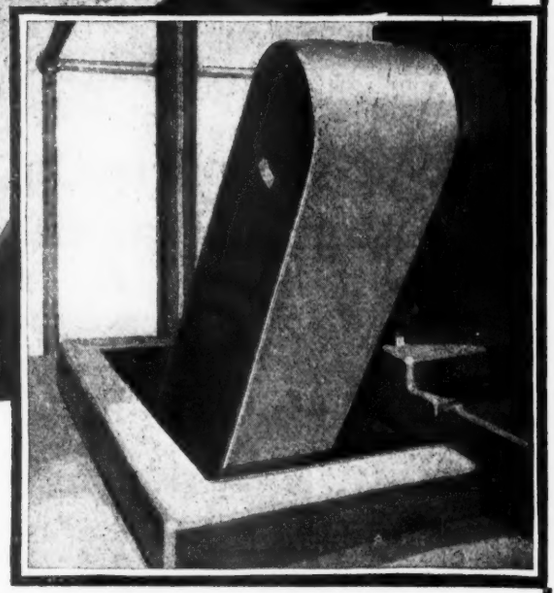

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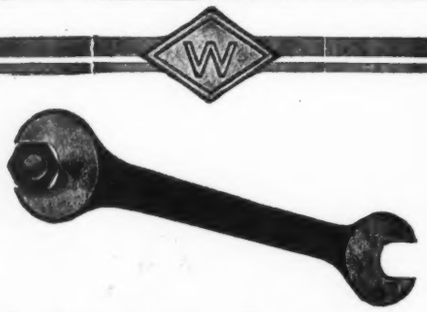

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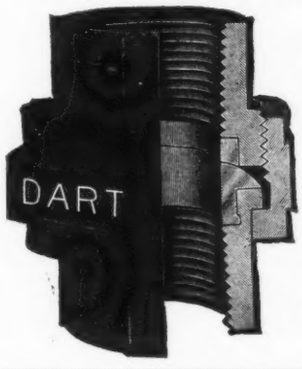

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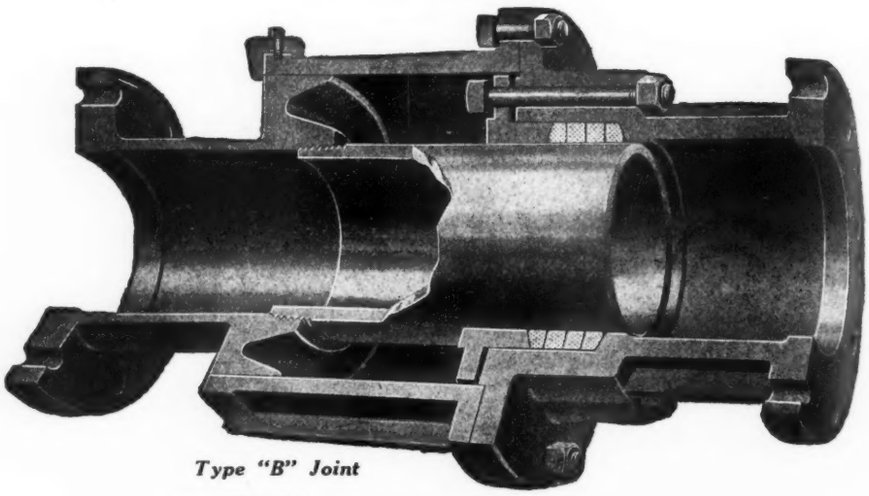

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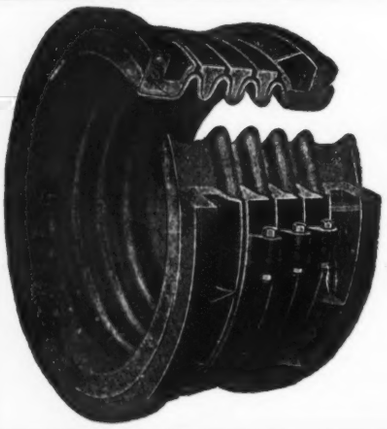

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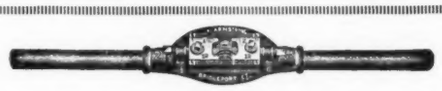

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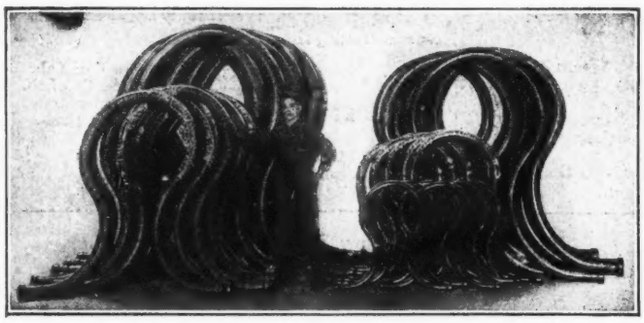

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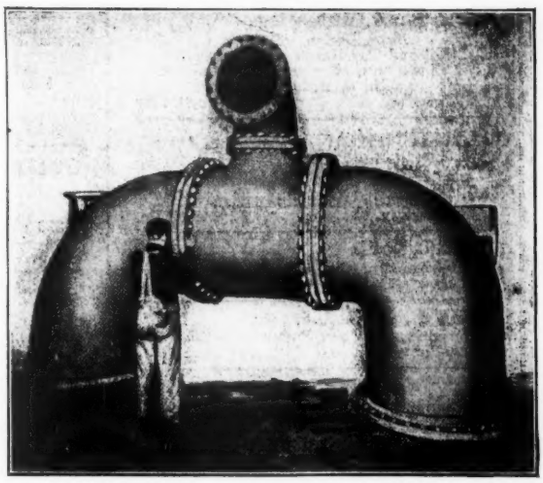

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DIESEL expert desires position as chief engineer of large Diesel power plant; 12 years' practical experience in active charge power plant construction operation and maintenance; technical; age 35, married; salary $3,600 per year. W. M. McNeil, 611 Erie St., Logansport, Ind.

Kentucky

CONSTRUCTION CREW — Consisting of gineers, mechanical and civil, steel workers, riggers, carpenters, concrete, clerical and executive men. First class men of long experience in construction work wish to connect with large construction company or builder doing work in South America, Europe or Alaska. Preferably in South America. Can handle any proposition in construction from start to completion. Want to hear from companies where mechanical experience, education and executive ability is needed and rewarded. PW-343, Power, Old Colony Bldg.,, Chicago.

New York

ENGINEERING draftsman, experienced in power station design, steam heating systems and general mechanical equipment. Academic and technical training. Age 26, married. Desires position in New England. PW-266, Power.

OPERATING engineer, 7 years' steam-electric, 2 years naval experience, wants position where executive ability and technical knowledge are required; salary $3,000-$3,600. PW-357, Power.

Power and Maintenance Executive

competent to supervise power equipment and plant maintenance. One who is thoroughly familiar with steam and electrical engineering and construction work. A man of pleasing personality who thoroughly understands his work, and can impart this information to others. This is a high grade position and offers unusual opportunity to the man who can qualify. We prefer a man now employed who is desirous of bettering his conditions by a change. Write, giving full particulars regarding experience and training, accompanied by a photograph.

P366—Power—Leader-News Bldg., Cleveland, Ohio

Notice to Advertisers

Owing to the coming holiday, the Searchlight Section of the July 6 issue will close for press 2 P.M., Tuesday, June 29.

Mail your copy as early as possible to insure its appearing in the issue desired.

POSITIONS WANTED

ENGINEER, qualified chief; five years operation and maintenance of steam-electrical power plants equipment desires permanent place, small plant within 75 miles of New York City preferred; good home location more consideration than high wages; satisfactory work assured. PW-272, Power.

GRADUATE mechanical engineer, 28, desires to get into the sales department of a manufacturing concern. PW-351, Power.

Rhode Island

ENGINEER—licensed egnineer—18 years' thorough practical experience on all types of engines and boilers, can operate and set up and cut the high cost of labor, cut fuel cost, can handle men to the best advantage, good knowledge of electricity and refrigeration and combustion. Now employed in a plant running oil burning capacity 850 hp. Will change for better position. Guarantee satisfaction with good wages. Age 37 and married. PW-368, Power.

EXTRA WORK WANTED

ENGINEERS and draughtsmen (3) with spare time and having sound marine and land experience, will supply designs and drawings for all classes of engineering; tracings also quickly executed; all business strictly confidential. XW-362, Power, Real Estate Trust Bldg., Phila.

AGENTS WANTED

Ash and Soot-Conveyor Agents

Wanted to sell most modern and efficient ash and soot conveyor on the market, including ash storage tanks. Experience not essential as real workers can average $1,000 a month at start. Co-operation and live leads furnished. United Stokers Corporation, Chicago, Illinois.

Boiler Plant Agents Wanted

Agents who call on boiler plants to represent old established firm in several open desirable territories. Commission basis. AS-188, Power.

SALESMEN AVAILABLE

Russian Representative Available

Engineer, Russian, would like to enter Russian field as representative for American manufacturers. AS-365, Power.

Sales Engineer Available

Would consider connection. Has had 20 years' experience as operating and chief engineer of steam, electrical and refrigerating plants; also about six years' experience selling; is a successful business builder and thoroughly acquainted with the trade in eastern Pennsylvania and the Baltimore district. AS-372, Power, Real Estate Trust Bldg., Philadelphia.

WANTED

Boiler Wanted

Wanted—Worthington water tube boiler, 80 or 100 hp.; must be in good condition. 860 De Kalb Ave., Brooklyn, N. Y. Decatur 5602.

PATENT ATTORNEYS

PATENTS, C. L. Parker, patent attorney, formerly member Examining Corps, U. S. Patent Office, McGill Bldg., Washington, D. C. Inventor's handbook sent upon request.

U. S. GOVERNMENT

Bids: July 7.

Refrigeration Plant

Dannemora, N. Y.

Sealed proposals for Refrigeration Plant and Cooling Rooms—Kitchen Building, Clinton Prison, Dannemora, N. Y. will be received by Charles F. Rattigan, Superintendent of State Prisons, Capitol, Albany, N. Y., until 12 o'clock noon, on Wednesday, July 7, 1920, when they will be publicly opened and read. Proposals shall be enclosed in an envelope furnished by the State Architect, sealed and addressed, and shall be accompanied by a certified check in the sum of five per cent (5%) of the amount of the proposal. The contractor to whom the award is made will be required to furnish surety company bond in the sum of fifty per cent (50%) of the amount of contract within thirty (30) days after official notice of award of contract and in accordance with the terms of Specifiation No. 3554.

The right is reserved to reject any or all bids.

Drawings and specifications may be examined and inspected at the Office of the Superintendent of State Prisons, Capitol, Albany, N. Y.; at the Office of the Warden of Clinton Prison, Dannemora, N. Y.; at the New York Office of the Department of Architecture, Room 618, Hall of Records Building, and at the Department of Architecture, Capitol, Albany, N. Y. Drawings and specifications and blank forms of proposal may be obtained at the Department of Architecture, Capitol, Albany, N. Y., upon reasonable notice to and in the discretion of the State Architect. L. F. PILCHER, Capitol, Albany, N. Y.

Dated: June 18, 1920.

U. S. GOVERNMENT

"ELECTRICAL HAND BOOK"

The "Burgess Blue Book" contains drawings and diagrams of Electrical Machinery and Connections—Starting Boxes, Elevators, Controllers, Starters for Printing Press Motors, Street Car Controllers, Transformer Connections, Lighting Circuits.

The section on Calculations takes up Simple Electrical Mathematics, Wiring Tables, Alternating Current Calculations, etc. It also gives 200 formulas, with problems worked out, showing their application.

Price $1.00. If you decide not to keep it, your money will be returned.

BURGESS ENGINEERING CO.
749 East 42nd St., Chicago, Ill.

FOR SALE

PRODUCTOGRAPH —AT A BARGAIN

Will keep count and curve drawing sheet record on 20 producing machines. Operates on 20-v. D.C. service.

Original cost $600. First-class shape. Various spare parts included.

W. A. HEFNER
c/o McGraw-Hill Co., 10th Ave. at 36th St., New York City.

WANTED

Plate Planer—Good, modern 20-ft. x 1¼-in. Plate Planer, preferably reversible, and with pneumatic clamps.

One 6 to 8-spindle **Drill**, suitable for drilling tube holes up to 3½-in. diameter.

W323—Power.
10th Ave., at 36th St., New York City

WANTED

2—150-hp. High Pressure **Boilers.**
1—100 to 150-kw., 250-volt Direct Current **Engine Driven Generator.**
1—400 to 500-ft. Compound Engine Driven **Air Compressor.**

W369—Power
1570 Old Colony Bldg., Chicago, Ill.

WANTED

MOTOR

1—250 H.P., 440 R.P.M., 25-Cycle, 440-Volt, Slip Ring Motor.

W. A. CARRELL & CO.
211-13-15 Second Avenue, Pittsburgh, Pa.

WANTED

One high-pressure
STEAM BOILER
for power use. Not less than 125 H.P. In first-class condition. Address

PAUL O. MORATZ
Bloomington, Illinois

WANTED
Second-hand steam-driven locomotive
CRANE
of late design, eight-wheel truck, 55 or 60 ft. boom with one yard bucket.
AJAX RUBBER COMPANY, INC.
218-222 West 57th St., New York, N. Y.

FOR SALE

600 H.P. Boiler Plant
NEW IN 1918

4—150 hp., 72 in. x 18 ft. Return Tubular Boilers for 125 lb. steam, butt strapped, triple riveted. 70—4 inch tubes. Set in battery of two boilers with angle iron frame for suspension. Fronts, shaking, grates and all fittings.

2—48 in. x 60 ft. long Smoke Stack, 3/16 in. plate with guy bands.

2—Cross smoke breechings made to use with two of above boilers. Set in battery.

Immediate shipment from Government plant. Chance to buy boilers in every way like new at a reasonable price. Location near Jersey City.

WICKES MACHINERY CO.
JERSEY CITY, N. J.

FOR SALE

STEAM ENGINES

1—16 in. x 18 in. Erie City, 125 hp. at 150 r.p.m. and 100 lb. steam pressure, with rope drive, complete, like new.

1—18 in. x 22 in. Erie City, 180 hp. at 135 r.p.m. and 100 lb. steam pressure, with rope drive, complete.

Natural Products Refining Co.
902-910 Garfield Ave., Jersey City, N. J.

350-HP. STIRLING BOILER

160 lbs., with Jones Underfeed Stokers with engine and blower, 100-ft. 48-in. stack; good condition. Unusual bargain.

Other excellent boiler and air compressor bargains.

BONSACK MACHINERY COMPANY
1601-4 Boatmen's Bank Bldg., St. Louis, Mo.

Power Machinery Exchange

INCORPORATED

1 MONTGOMERY STREET, JERSEY CITY, N. J.

3-Phase, 60-Cycle A. C. Units

300-Kw. G. E., 2300-Volt, 3-Phase, 60-Cycle, With Harrisburg Side Crank 4-Valve Tandem Engine

Kw.	Generator	Volts	Engine
800	Al.Chal.	2300-200	Reynolds, 30 x 48
800	Al. Chal.	440-220	Al. Chal. cor.
600	G. E.	2300-220	Corliss, cross comp.
450	G. E.	600-220	Rice, Sargeant, cor.
400	Wghse.	480-240	Erie Ball, 4-valve
360	G. E.	2300-550-220	Harris, cor., 250 rpm.
300	G. E.	2300	Harrisburg, side c.
250	G. E.	600-220	Reynolds, 16 x 36
250	G. E.	2300	Harrisburg, tandem
165	Wghse.	2200-220	Harrisburg, side c.
156	Wghse.	440	Parsons Turbine
150	G. E.	440-220	Chandler Tay, s. c.
125	Al. Chal.	220-440	Buckeye, heavy s. c.
100	Ridgway	220	Lycoming, side crank
100	Ridgway	2300-220	Ridgway, 4-valve
75	(2) G. E.	2300-220	Ideal tandem
75	Cr. Wh.	2300-220	Russell, side crank
75	Ridgway	2300	Ridgway, side crank
36	G. E.	240	Harrisburg, side crank

A. C. Motors (60 Cycles)

Hp.	Make	Phase	Volts	Speed
250	G. E.	3	2300	900
200	Wghse.	3	440	580
125	G. E.	3	440	900
100	Wghse.	3	230	1170
100	Al. Chal.	3	220	860
85	G. E.	3	2080	720
75	Wghse.	3	550	720
7½	G. E.	2	220	1800
1	Emerson	1	220-110	1750

110-125-Volt Generators

Kw.	Make	Type	Speed
100	Burke	MP	600
75	G. E.	H	550
60	Walker	MP	700
60	Wghse.	S	800
50	G. E.	L	260
37½	G. E.	H	700
17½	G. E.	H	1080
17	Triumph	MP	1200
15	Bernard	MP	1250
12½	Card	MP	850
11	G. E.	CQ	800
10	Wghse.	S	1325
9½	G. E.	CVC	905
6	Wghse.	S	1675
4½	G. E.	IB	1800
4½	Wghse.	M	1600

Corliss Engines

32 x 48 Allis Chalmers.
26 x 48 Hawes & Phillips.
21 x 56 Watts Campbell.
24 x 48 Hewes & Phillips.
24 x 42 Vilter.
22 x 48 Murry.
22 x 48 Allis.
20 x 42 Allis.
18 x 48 Lane & Bodley.
18 x 42 Allis.
16 x 36 Allis.
14 x 36 Allis.
14 x 32 Hewes & Phillips.

220-250-Volt Dir. Con. Units

Two 300-Kw. G.E., 3-Wire, 250-125 Volts, Dir. Con. Erie Ball 4-Valve Engines; Latest Type; Used 2 Years; Practically New; Still on Foundation

125-Kw. Wghse., 3-Wire, 125-250-Volt, With Chandler-Taylor Side Crank Heavy Duty Latest Type Engine, Like New

Kw.	Generator	Engine
480	G. E.	McIntosh & Sey., ver.
450	C. W.	Nordberg, Uniflow, cor.
300	Goodman	Ridgway, cross comp.
200	Wghse.	Erie Ball, side crank
150	Burke	Harrisburg, side crank
150	Al. Chal.	Al. Chal., 18 x 36
150	Ridgway	Ridgway
125	Wghse. 3-wire	Chand. Tay., side crank
115	W. E.	Russell, 4-valve
100(2)	Sturtevant	Sturtevant, vertical
75	Wghse., 3-wire	Harrisburg, tandem
75	Wghse., 3-wire	Skinner
75	Wghse.	Wghse, vertical
75	G. E.	Skinner
62½	G. E.	Ames
50	Wghse., 3-wire	Harrisburg
50	Wghse., 3-wire	Harrisburg
50	Cr. Wheeler	Frost
35	G. E.	Harrisburg, side crank
30	Engberg	Engberg, vertical
25	Wghse.	Erie Ball
25	G. E.	Troy, vertical
15	G. E.	Harrisburg, side crank

220-250-Volt Generators and Motors

Kw.	Make	Type	Speed
650	Burke	12 pole	350
325	Jenney	6 pole	400
300	Wghse.	6 pole	450
250	G. E.	6 pole	500
150	Wghse.	6 pole	225
150	G. E.	6 pole	400
100	Triumph	6 pole	675
85	G. E.	CLB	800
75	G. E.	6 pole	725
60	National	CS	875
56¼	Wghse.	MP	800
50	G. E.	H	515
40	Milwaukee	MP	650
30	G. E.	H	1050
27(2)	G. E.	H	360
25	G. E.	Crane	800
15	G. E.	MP	1300
15	Wghse.	S	1150
13½	Al. Chal.	MP	1175
10	Wghse.	M	750
10	Akron	MP	1425

3-Phase, 60-Cycle Alternators

Kw.	Generators	Volts	Speed
350	Stanley	2300	600
240	Elec. Machy.	2300	257
200	Al. Chal.	440-240	900
200	G. E.	2300	600
100	G. E.	2300	900
100	G. E.	440-220	900
75	G. E.	440-220	1200
50	Wghse.	220	1200

Oil and Gas Direct Connected Units

500-HP. Diesel Oil Engine, Perfect Condition, Seen Running

Kw.	Make	Type	Engine
200	F. M.	3-ph., 60-cyc.	F. M. 4-cyl. gas
200	F. M.	3-ph., 60-cyc.	Bruce MacB. gas
175	W. E.	3-ph., 60-cyc.	Sheffield, 3-cyl. gas
160(2)	G. E.	3-ph., 60-cyc.	Diesel, 3-cyl. oil
152	G. E.	3-ph., 60-cyc.	Bruce MacB. 4-cyl. gas
120	Burke	3-ph., 60-cyc.	Bruce MacB. 4-cyl. gas
85	Wghse.	3 wire, 220-110 v.	Wghse. 3-cyl. gas
75	Wghse.	250 volt, d.c.	Wghse. 3-cyl. gas
75	G. E.	125 volt d.c.	Diesel, 3-cyl. oil
60(2)	C. W.	125 volt d.c.	Diesel, 3-cyl. oil
50	G. E.	3-ph., 60-cyc.	Rathburn, 2-cyl. gas
37½	F. M.	2-ph., 60-cyc.	F. M., 2-cyl. oil

110-125-Volt Dir. Con. Units

100-Kw. Wghse. 6-Pole Compound Generator, With Skinner Heavy Duty Engine. Like New

Kw.	Generator	Engine
200	Triumph	Ide, side crank 21x20
200(2)	Al. Chal.	Allis, 22x36
150	G. E.	Harrisburg, side crank
150	Wghse.	Ball, 4-valve
125	Bullock	Ball
100	G. E.	Harrisburg, side crank
100	Al. Chal.	Allis, 16x36 corliss
100	Wghse.	Skinner
75	Cr. Wh.	Ames
75	G. E.	G. E., vertical marine
65	Burke	Harrisburg, side crank
60	G. E.	Harrisburg, side crank
50	G. E.	Harrisburg, side crank
50	Wghse.	Harrisburg, side crank
35	Wghse.	Ames
25	G. E.	Harrisburg, side crank
25	Burke	Chand. Tay., side crank
25	Ridgway	Ridgway, side crank
25	G. E.	Bates, vertical
20	Akron	Harrisburg, side crank
15	G. E.	A. & S., vertical

Boilers

Two 600-HP. Babcock-Wilcox Watertube Boilers, 200 Lb. Pressure. Seen Operating

4—150-hp., Return Tubular Boilers, butt, triple, 125 lb., with stokers. Seen operating.
2—300-hp. Heine W. T., 150 lb. Seen operating.
5—200-hp. Return Tubular Boilers, butt, triple, 135 lb. Seen operating.
1—200-hp. Heine W. T., 150 lb.
1—130-hp. Heine W. T., 150 lb.

War Department

ORDNANCE SALVAGE BOARD

Surplus Property Sales

Opportunities for All

Consumer — Retailer — Dealer — Jobber — Wholesaler Manufacturer

The U. S. Ordnance Salvage Board is offering for sale through its several District Offices, listed below, large quantities and diversified classes of Materials and Equipment. The items detailed on the following pages are given merely as a suggestion of these various classifications. Read each page carefully. The items described are listed under the respective Districts by which they are held; they are not grouped into classifications.

These sales embrace items of value to almost every branch of modern industry.

Materials to be sold by NEGOTIATION

Sales methods are simple. All items, unless otherwise stated, are offered for sale by negotiation, and in lots sufficiently small to give all prospective purchasers an opportunity to buy.

IMPORTANT—Statements as to chemical analysis, specifications, conditions, or exact quantities are based on the best information available, but no guarantee on behalf of the Government can be given. Purchaser will be required to accept the material "as is" in its present condition. Inspection is therefore invited. Failure to inspect will not be considered a warrant for rejection or cancellation.

CERTIFIED CHECK, cashier's check, draft or legal tender for full amount must accompany shipping instructions. Checks to be made payable to the "Treasurer of the United States."

ALL OR ANY PART of material listed may be bid on or sold.

UNIT—Submit bid in terms of units listed, that is, quote price per piece, foot, gallon, 100 lbs. or gross ton, etc.

F. O. B. POINT—Quote price f.o.b. cars at plant where material is located or "on ground" if contractor buys material at his plant.

WEIGHTS—Government weights at point of shipment will govern.

DIFFERENCES IN WEIGHTS—If any difference between the weights indicated in this Bulletin and the actual weights should be discovered, the Government will refund or forward an invoice to the purchaser to cover any discrepancy and final settlement will be based on affidavits as to correct weights.

SHIPPING INSTRUCTIONS stating desired rate of delivery and name of delivering railroad in writing must reach the Committee interested within fifteen days from date award is made. The Government reserves the right to forward the entire shipment at a steady rate or as rapidly thereafter as shipping facilities will permit, unless special arrangements at time of purchase are made with the Committee to modify shipping procedure.

DEMURRAGE—The Government is not responsible for any demurrage, and any such charges accruing shall be paid by the purchaser.

SUBJECT TO PRIOR SALE

All items offered are subject to prior sale. Place your order promptly. Write or telegraph today.

Get the current DISTRICT BULLETINS

This advertisement covers only a small part of the materials and equipment offered for sale by the several Ordnance District Salvage Boards. Each District Office issues a weekly bulletin which describes in detail what that particular District has for sale. Write to the District Offices for their bulletins. The current copies will be mailed to you promptly.

If you desire to receive regularly the bulletins of any or all of the Districts, request that your name be placed on the mailing lists.

Watch for Succeeding Announcements

Ordnance District Salvage Boards:

District	Address		Telephone Number
BOSTON	19 Portland St.	Boston, Mass.	Army Wire
BALTIMORE	Columbia Ave. at B. & O. R.R.	Baltimore, Md.	
BRIDGEPORT	945 Main St.	Bridgeport, Conn.	Noble 791
CHICAGO	74th and Ashland Ave.	Chicago, Ill.	Vincennes 3500
CINCINNATI	3rd and Vine Sts.	Cincinnati, Ohio	Main 3732
TOLEDO	Storage Depot, No. 1	Toledo, Ohio	
DETROIT	35 Washington Blvd.	Detroit, Mich.	Cadillac 7680
NEW YORK	1107 Broadway	New York City	Army Wire
PHILADELPHIA	1710 Market St.	Philadelphia, Pa.	Locust 5120
PITTSBURGH	Neville Island	Coraopolis, Pa.	30162
ROCHESTER	1048 University Ave.	Rochester, N. Y.	Chase 4480
ST. LOUIS	Missouri State Life Bldg.	St. Louis, Mo.	Olive 6960
MONTREAL	Notre Dame St., E.	Montreal, Canada	
OLD HICKORY	Jacksonville, Tenn.	Jacksonville, Tenn.	

See opposite page for details of a few items offered

War Department
ORDNANCE SALVAGE BOARD
Surplus Property Sales

OLD HICKORY DISTRICT
Old Hickory Powder Plant, Jacksonville, Tennessee

ALLIS-CHALMERS CORLISS ENGINES
350 Horse Power, Heavy Duty Type

Lot 1577. 20—Corliss Engines, 18-in. x 36-in., 125 r.p.m., 350-hp., fly wheel 11-ft. diam., 32-in. face, operated on 140 lbs. steam gauge pressure, 1½-in. gauge back pressure. Oil guards for crank eccentric. Complete housing for connecting rod and crank. Cylinders threaded with V groove about 1/32-in. deep. Four threads to inch to improve lubrication. Double eccentric allowing cut-off up to 75 per cent of stroke. All engines belted away from cylinders. Throttle valve furnished 6-in. steam inlet.

Each engine is equipped with one complete Richardson Phoenix Lubricating System, consisting of oil pump, filters, etc. Twelve of the above engines are right-hand operating, and eight are left-hand operating. These engines have been used, but have received excellent care.

All parts are painted and greased to prevent oxidation of finished surfaces.

BLACK IRON PIPE BENDS
At Fixed Prices

The Old Hickory District has for sale miscellaneous Black Iron 90° Pipe Bends, ranging in size from 2-in. diameter with 1-ft. radius bend to 16-in. diameter with 6-ft. 6-in. radius bend. There are also 75 Black Iron U Bends, ranging in size from 3-in. diameter to 12-in. diameter. Practically all of these U Bends have 5-ft. radius with ends 10-ft. center to center.

The Bends are standard or extra heavy weights with screw or Van Stone flanges. Complete description, condition, dimensions, etc., are contained in the latest District Bulletin.

This material will be sold at fixed prices.

The Old Hickory District also offers for sale additional surplus material such as standard and narrow gauge railroad equipment, screen doors, sanitary supplies, soil pipe and fittings and miscellaneous hardware items. Send for the latest Old Hickory District Bulletin which gives complete details.

CHICAGO DISTRICT
74th and Ashland Ave., Telephone Vincennes 3500

IDEAL STEAM DRIVEN D. C. GENERATOR SETS

225-250-volts, 200-kw., 200 r.p.m. A. L. Ide & Sons 16/26-in. x 18-in. center crank, tandem compound condensing Engine of 340 I.H.P. with 125 lb. gauge pressure at throttle and 26-in. vacuum. Direct connected to G. E. 200-kw. continuous current compound generator, type MP., class 8-200-200; 8-pole, 225-volt no load, 250-volt full load; 800 amp., 200 r.p.m.

MOTORS

9—Otis Elevator Co., 25-hp., type 6, No. 17 A.C., 440-volt, 33 amp., 900 r.p.m., 3-phase; complete. Location: Chicago Storage Depot, Chicago, Ill.

Chicago District offers for sale the items listed on this page only
AT FIXED PRICES
NO DELAYS NO RESTRICTIONS

The information covering machines and equipment listed on this page has been obtained from the best sources available. The Government invites inspection before purchase, and assumes no responsibility as to condition or completeness.

All machines and equipment listed on this page are subject to prior sale. No options will be granted. Sales will be made for cash only.

Information regarding inspection, location, etc., may be obtained upon application to Chicago District Ordnance Salvage Board.

AIR COMPRESSORS

1—Sullivan Mach. Co., 2-stage W. J., 18-in. x 11-ft. x 14-in., belt driven, 675 cu.ft. free air displaced per min., 225 r.p.m., 125-hp., 100 lbs. BHP. Location: Twin City Forge & Foundry Co., Stillwater, Minn.

1—Sullivan Mach. Co., W. G. 3, single stage, 12-in. x 12-in., belt driven, 350 cu.ft. free air dis. per min., 225 r.p.m., 40-hp., 100 lb. BHP. Location: Twin City Forge & Foundry Co., Stillwater, Minn.

TRANSFORMERS

1—General Electric Co., type A, form L, 60-cycle, 10800/12000 volts, 115/230 volts, 150-kva. Location: Chicago Storage Depot, Chicago, Ill.

1—General Electric Co., type A, form L, 60-cycle, 10800/12000 volts, 150/230 volts, 250-kva. Location: Chicago Storage Depot.

The Chicago District also offers for sale additional surplus machinery and metal items, miscellaneous power, electrical, chemical, hardware and shop equipment items, all of unusual interest to power plants.

Send for latest Chicago District Bulletin which gives complete details.

Write TODAY for Latest Current Bulletins

STOCK SHIPMENT

DIRECT CURRENT MOTORS—230 Volts

No.	Hp.	R.p.m.	Wdg.	Type	Make
1	½	650	Sh	CM	Cr. Wh.
2	7½	825	Cp	B-7	Milwaukee
1	7½	825	Sh	13	Milwaukee
1	7½	950	Cp	K	Allis-Chal.
1	10	635	Sh	MP	Gen. Elec.
1	10	1150	Sh	S	Westghse.
1	13	1750	Sh	SL	C & C
1	20	600	Sh		West. Elec.
1	20	600	Sh	S	Westghse.
1	20	650	Sh		Northern
1	20	650	Sh		Milwaukee
1	20	900	Sh	MP	Hobart
1	20	850	Sh	S	Westghse.
2	22	1050	Cp	B-51	Milwaukee
1	40	920	Cp	MP	Jenny
1	40	950	Sh	B-25	Milwaukee
1	40	950	Cp	EB5A	West. Elec.
1	45	800	Sh		Imperial
1	45	600/1200	Sh		Northern
1	50	525	Cp		Northern
1	55	575	Sh	E6½AOR	West. Elec.
1	75	800	Cp	A-50	Milwaukee
3	90	1000	Cp	A-50	Milwaukee
1	95	575	Sh		Jenny
1	115	1000	Cp	DLC	Gen. Elec.
1	267	468	Cp		Commer.
1	650	315	Sh		Burke

DIRECT CURRENT GENERATORS
230 Volts

No.	Kw.	R.p.m.	Wdg.	Type	Make
2	5	935	Cp	B-7	Milwaukee
1	5	925	Sh	13	Milwaukee
1	7½	1325	Sh	S	Westghse.
1	10	1950	Cp	SL	C & C
1	15	1025	Sh	MP	Hobart
1	15	690	Sh	MP	West Elec.
1	15	725	Sh	MP	Milwaukee
1	30	1020	Cp	MP	Jenny
1	13	1100	Sh	B-25	Milwaukee
1	30	1025	Cp	5-A	West. Elec.
1	35	900	Sh	MP	Imperial
1	40	600	Cp	MP	Northern
1	56	920	Cp	A-50	Milwaukee

DIRECT CURRENT GENERATORS—Con't.
230 Volts

No.	Kw.	R.p.m.	Wdg.	Type	Make
3	70	1150	Cp	A-50	Milwaukee
1	70	675	Cp	MP	Jenny
1	80	1050	Cp	DLC	Gen. Elec.
1	85	1150	Cp	DLC	Gen. Elec.
1	200	550	Cp		Commer.
1	500	375	Sh	MP	Burke
1	625	275	Sh	MP	Burke

MOTOR GENERATOR SETS
230 to 250 Volts

1—5 Kw. 230 V. D.C. 1150 RPM. cp.wd. Type K Allis-Chalmers Generator, direct connected to 1—new 220 or 440 V. 3 ph. 60 cy. Allis-Chalmers induction motor complete.
1—10 Kw. 230 V. D.C. 1750 RPM. sh. wd. Type SL C & C Generator, direct connected to 1—new 220 or 440 V. 3 ph. 60 cy. AN Allis-Chalmers induction motor complete.
1—25 Kw. 230 V. D.C. 1800 RPM. Western Electric Generator, direct connected to 1—new 2200 V. 3 ph. 60 cy. Type CCL Westinghouse induction motor, complete.
1—30 Kw. 250 V. D.C. 1150 RPM. cp. wd. Type E-B5A Western Electric Generator, direct connected to 1—new 220 or 440 V. 3 ph. 60 cy. Allis-Chalmers induction motor, complete.
1—56 Kw., 230 V. D.C. 860 RPM. cp. wd. Milwauke Generator, direct connected to 1—new 220 or 440 V. 3 ph. 60 cy. Allis-Chalmers induction motor, complete.
1—56 Kw., 250 V. D.C. 900 RPM. cp. wd. Milwaukee Generator, direct connected to 1—2300 V. 3 ph. 60 cy. Allis-Chalmers induction motor, complete.
3—65 Kw. 230 V. D.C. 1150 RPM. cp. wd. Milwaukee Generators, direct connected to 3—220 or 440 V. 3 ph. 60 cy. Type CS Westinghouse induction motors, complete.
1—76 Kw. 125/250 V. D.C. 3 wire Western Electric Generator Set consisting of 2—38 Kw. 125 V. Western Electric generators, belted or chain driven by 1—new 220 or 440 V. 3 ph. 60 cy. Allis-Chalmers induction motor, complete.
1—80 Kw. 250 V. D.C. 1150 RPM. Type DLC cp. wd. General Electric Generator, direct connected to 1—2200 V. 3 ph. 60 cy. Type CS Westinghouse induction motor, complete. (New)
1—100 Kw. 275 V. 900 RPM. cp.wd. Type SK Westinghouse Generator, direct connected and mounted on common base to 1—2200 V. 3 ph. 60 cy. Westinghouse Synchronous motor with A.C. starting equipment and D.C. panel.
1—150 Kw. 125/250 V. D.C. 3 wire Burke Electric Generator Set, consisting of 2—75 Kw. 125 V. cp. wd. Burke generators, belted or chain driven by 1—new 2200 V. or 440 V. 3 ph. 60 cy. Allis-Chalmers induction motor, complete.

DIRECT CURRENT ENGINE GENERATOR SETS—230 to 250 Volt

2—50 Kw. 125-250 V. 285 RPM. Burke cp. wd. Generators, direct connected to 85 HP. 3 cylinder Walrus gas engine, complete with all accessories.
1—56 Kw. 250 V. Type MP Milwaukee Generator, belted to Ball steam engine 90 HP. 100 to 125 lbs. steam pressure, complete with all accessories.
2—75 Kw. 250 V. cp.wd. 290 RPM. Westinghouse Generators, direct connected to 1—125 HP. automatic Westinghouse steam engine, complete with all accessories.
1—80 Kw. 250 V. D.C. cp. wd. Type DLC General Electric Generator, belted to 125 HP. 100 to 125 lbs. steam pressure, Lord Howler steam engine, complete with all accessories.
1—80 Kw. 250 V. cp. wd. Type MP General Electric Generator, belted to 1—Reeves 125 HP. gas engine, complete with all accessories.
1—100 Kw. 250 V. 250 RPM. 400 Amp. cpwd. Westinghouse Generator, direct connected to Buckeye 150 HP. Twin Tandem gas engine, complete with all accessories.
1—150 Kw. 250 V. 200 RPM. cp.wd. Westinghouse Generator, direct connected to 1—Ridgway horizontal steam engine, 19 in. bore, 20 in. stroke, 225 HP. 200 RPM. steam pressure, 125 lbs., complete with all accessories.
1—250 Kw. 275 V. 175 RPM. cp.wd. Ridgway Generator, direct connected to Ridgway Horizontal steam engine, 23 in. bore, 24 in. stroke, 125 lbs. pressure, complete with all accessories.

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New and used Electrical Equipment
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Reliable—POWER PLANT MACHINERY

DIRECT CURRENT GENERATORS

Belted and Direct Connected

1—7-kw. Jantz & Leist, 125-volt, 1000-r.p.m., compound wound belted type Generator.
1—17½-kw. Triumph, 125-volt, compound wound, enclosed type Generator, direct connected to an 8 x 8 Troy vertical automatic engine on same base.
2—50-kw. each, 125-volt Westinghouse, 400-ampere 275-r.p.m., direct current, compound wound Generators, each direct connected to a 10 x 12 Erie Ball enclosed type automatic right-hand engine, with oiling system and accessories.
1—75-kw. General Electric, 125-volt, 600-ampere, 275-r.p.m., compound wound, direct current Generator, direct connected to a 14½ x 14 Russell left-hand, automatic engine with accessories.
1—100-kw. Triumph, 125-volt, 675-r.p.m., compound wound, belted type Generator.
1—100-kw. Allis-Chalmers, 125-volt, direct current, compound wound Generator, direct connected to a 14 x 16 Ball automatic enclosed type, left-hand engine, with accessories and switchboard. (Will also furnish for 250-volt.)
2—150-kw. Milwaukee Electric Company, 250-volt, direct current, compound wound Generators, each direct connected to an 18 x 16 Harrisburg automatic piston valve engine with accessories and switchboard.

A. C. GENERATORS

Belted and Direct Connected

1—800 K.W. Allis-Chalmers, 3 phase, 60 cycle, 480 volt A. C. Generator direct connected to a 26 x 44 x 48 cross compound Allis-Chalmers heavy duty Corliss Engine.
1—500-kw. General Electric, 3-phase, 60-cycle, vertical Turbo Generator Set with condenser and accessories.
1—125-kw. Western Electric, 3-phase, 60-cycle, 240-volt, 257-r.p.m. revolving field, A.C. Generator, direct connected to a 15 x 16 Skinner automatic, enclosed type, right hand, self-oiling Engine, with belted exciter, switchboard and instruments.
1—90-kva. Electric Machinery Company, 3-phase, 60-cycle, 2200-volt, 1200-r.p.m., revolving field belted type alternator.

DIRECT CURRENT MOTORS

No.	Hp.	Make	Volts	R.p.m.
1	50	Rebuilt Allis-Chalmers	250	800
1	30	Rebuilt Northern	220	600
1	10	Rebuilt Triumph	250	1100
1	10	Rebuilt Triumph	220	1150
1	10	Rebuilt Jantz & Leist	220	750
1	8	Rebuilt Jantz & Leist	110	750
1	7½	Rebuilt Jantz & Leist	220	800
1	7½	Rebuilt Interpole	220	550-1100
1	5	Rebuilt Triumph	115	1300
1	5	Rebuilt Triumph	220	1300
1	5	Rebuilt Fairbanks-M	220	1175

BOILERS

2—400-hp. Sterling, 160-lb. pressure.
2—250-hp. Sterling, 150-lb. pressure.
1—200-hp., 84 x 18, high pressure, return tubular.
4—150-hp., 72 x 18, high pressure, return tubular.
1—125-hp., 72 x 16, high pressure, return tubular.
3—100-hp., 66 x 16, high pressure, return tubular.
2—100-hp., 66 x 16, horizontal, return tubular.
1— 80-hp., 60 x 16, horizontal, return tubular.
1— 60-hp., 54 x 14, horizontal, return tubular.
2— 50-hp., 48 x 14, horizontal, return tubular.
1— 30-hp., 44 x 10, high pressure, return tubular.
1— 20-hp., 36 x 101, new Ohio standard, vertical.
1— 15-hp., 36 x 83, new Ohio standard, vertical.
1— 10-hp., 30 x 83, new Ohio standard, vertical.
1— 8-hp., 20 x 68, new Ohio standard, vertical.
1— 5-hp., 24 x 65, new Ohio standard, vertical.

MOTOR GENERATOR SETS

1—Used 100-kw. Triumph, 125-volt, 800-ampere, compound wound, direct current Generator, direct connected to a 150-hp. Westinghouse, 3-phase, 60-cycle, 2200-volt, 720-r.p.m., squirrel cage induction motor with rheostat and starter.

MOTORS

Alternating Current, 3-Phase, 60-Cycle Squirrel Cage and Slip Ring

No.	Hp.		Make	Volts	R.p.m.
2	10	Used	G. E.	220	1200
2	10	New	Triumph	220	1800
1	15	Used	Cr.-Wh.	440	850
1	15	Used	G. E.	220	850
2	20	New	G. E.	440	1800
1	25	New	G. E.	440	1800
1	25	Used	G. E.	220	600
1	30	New	G. E.	220	1800
1	30	New	G. E.	220	1200
1	30	New	G. E.	220	900
1	40	New	G. E.	220	1800
2	40	New	G. E.	220	1200
5	40	New	G. E.	440	1200
1	40	New	G. E., slip ring	440	1200
1	50	New	G. E.	220	1800
2	50	New	G. E.	220	900
2	60	New	G. E.	220	900
3	75	New	G. E.	220	1200
2	75	New	G. E.	220	900
1	75	Used	Wstgh.	440	700
1	75	Used	Wstgh.	220	1120
1	75	New	G. E., slip ring	440	900
1	100	Used	Wstgh.	220	1200
3	100	New	G. E.	220	900
1	150	Used	Wstgh.	2200	720

STEAM ENGINES

1—17 x 34 x 48 Hamilton cross compound, heavy duty Corliss.
1—16 x 34 x 48 Hamilton tandem compound, heavy duty Corliss.
1—18 x 36 Hamilton heavy duty Corliss.
1—18 x 30 Allis heavy duty Corliss.
1—18 x 24 Atlas automatic four valve.
1—14 x 30 Hamilton heavy duty Corliss.
1—14 x 24 Houston, Stanwood & Gamble slide valve.
1—12 x 16 Chandler & Taylor slide valve.
1—12 x 12 Erie City automatic.
1—11 x 15 Erie automatic.
1—11 x 12 Skinner automatic.
1—10 x 12 Brownell slide valve.
1— 9 x 12 Chandler & Taylor slide valve.
1— 8 x 10 Brownell slide valve.
1— 7 x 7 American Blower piston valve.
1— 4 x 5-hp. Clark vertical.

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If you are looking for pumps it will pay you to investigate our offerings. We have available one of the largest stocks of used pumps in the country. Practically every size and style included.

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We have pumps you can use

Let us know your pumping problems. Our engineers who specialize in this line will be glad to help you.

Here are just a few items in pumps we have to offer:

Maker	Size	Discharge	Suction	GPM	Water Pressure	Type
Worthington	5¼x3½x5″	1½″	2½″	84	150	Outside Packed Plunger
"	7½x8½x10″	5″	6″	470	75	Du. Packed Piston
"	12x7x10″	5″	6″	300	200	Outside Packed Plunger
"	6x9x8½x10″	5″	6″	300	75	Comp. Du.
"	10x6x12″	....	....	....	....	Du. Packed Piston
Snow	6x2½x6″	2″	3″	39	....	Du. Packed Piston
Worthington	12x18x8½x12″	....	....	235	....	Comp. Du.
"	16x25x3¼x18″	....	....	58	3000	Comp. Du.
Canton Hughes Co.	5¼x3½x6″	1½″	2″	....	....	Duplex
Worthington	5¼x3½x6″	1½″	2½″	....	....	Duplex
"	14x20x2⅝x18″	....	....	....	....	H P Hydraulic
American		5″	7″	750	100	EE—Direct
Allis-Chalmers		6″	6″	1750	....	"S"—Direct
Gould		8″	8″	1750	120	Split Casing Direct
Kutztown Fdy. Co.		3″	4″	332	40	Vertical Belt
Shevlin Mfg. Co.		3″	5″	332	40	Circulating Belt
Rumsey		3″	4″	200	....	Sludge Pump—Belt
Pusey & Jones		3″	6″	....	....	

We also have many odd patterns, originally built to suit extraordinary or peculiar conditions. These are listed at especially attractive prices.

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- Pumps ☐
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THE EMERGENCY FLEET CORPORATION
HEINE COLVIN and Other Standard Makes

250 H. P. 300 H. P. 325 H. P. 350 H. P. 400 H. P. 500 H. P.

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This big purchase from the United States Shipping Board, Emergency Fleet Corporation brings us the entire surplus stock of new high grade Water Tube Boilers. We are now about to offer an unusually attractive proposition to everyone interested in highest quality Steam Power Equipment. All boilers are built under rigid Government supervision and under the inspection of Lloyd's, American Bureau and United States Steam Boat Inspection Service. All boilers are perfectly adapted for land or marine purposes and are good for 200 lb. pressure or more. They are all steel encased and self-contained—adapted to hand firing or stoker application. Oil burning, coal burning or gas burning.

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Competent engineers are ready to serve you and lend their assistance in the installation of your Steam Power Equipment.

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A No. 1 POWER APPARATUS

IMMEDIATE DELIVERY

A. C. UNITS

1—800 Kw. General Electric, Revolving Field Engine type Alternator, 60-cycle, 3-phase, 2300-v., direct connected to heavy duty Cross Comp. Corliss Engine.

1—400 Kw., Westinghouse, 60-cycle, 2- or 3-phase, 2200-v., D. C. to Cross Compound 4-valve Engine, 150 rpm.

1—400 Kw. Crocker-Wheeler Revolving Field Engine type Alternator, 60-cycle, 3-phase, 220-440-v., 225 rpm. No Engine.

2—300 Kw. Westinghouse R. F., Engine type Alternators, 25-30-cycle, 3-phase, 400-400-v., D. C. to Cross Compound Allis Corliss Engine.

1—300 Kw., G. E., 60-cycle, 3-phase, Alternator, 2300-v., D. C. at 150 rpm. to Tandem Automatic Engine.

1—325 Kva. Revolving Field, E. T. Alternator only, 60-cycle, 3-phase, 2300-v., 164 rpm.

1—650 Kw., Revolving Field, E. T. Alternator only, 60-cycle, 3-phase, 480-v., for direct connection at 170 rpm.

1—937 Kva. (750 Kw.), 60-cycle, 3-phase, 440-volt Revolving Field Alternator, direct connected to Erie City Lenze type. Practically new.

BELTED D. C. UNITS

2—400 Kw., 250-v., M. P., 3 Bearing Westinghouse Generators; 375 rpm., with suitable Corliss Engines.
150, 200, 250 and 300 Kw. BELTED MULTIPOLAR GENERATORS WITH OR WITHOUT CORLISS OR AUTOMATIC ENGINES.

TURBINES

2—2000-3000 Kw. Westinghouse Condensing or Non-Condensing type Turbo-Alternator Units, 60-cycle, 3-phase, 480, 550 or 2300-volts, at 200 r.p.m. Complete with 5700 sq. ft. Wheeler Condenser outfit, or Westinghouse, No. 11 LeBlanc Jet Condenser. In operation less than two years. Condition A No. 1.

1—1500-2000-kw. capacity late type General Electric Horizontal, Condensing, 60-cycle, 3-phase, 2300-volt Turbo Alternator Unit. Practically new. Complete with Barometric Condenser and all Accessories.

2—1250 Kw. Westinghouse Condensing or Non-Condensing or Bleeder type. 60-cycle, 3-phase, 480, 2300 or 11,000-volt.

BOILERS

2—480 hp. Stirling butt joint construction, 160 lb. with stacks, stokers and all fittings.

6—420 hp. B. & W. Steel Header Water Tube Boilers, 150 lb. working pressure; equipped with Superheaters and Mechanical Stokers.

2—250-hp. Heinie, 115-140-lb.; complete plant, including Heater, Pumps, Piping and all fittings.

ENGINES

1—26 and 52 x 48 Heavy Duty Cross Compound Corliss Engine, with rope wheel.

1—24 and 50 x 48 Heavy Duty Cross Compound Corliss Engine, with belt wheel, 18-ft.

1—250 hp. Ideal Tandem Compound, 14 and 22 x 16 Automatic.

2—26 x 48 Hamilton Girder Frame Corliss, Wheel 20-ft. x 41-in.

1—22 x 48 Harris Left Hand Corliss, Wheel 16-ft. x 32-in.
HEAVY DUTY CORLISS, AUTOMATIC AND FOUR VALVE ENGINES, RANGING IN SIZES FROM 100 TO 1500 HP. CAPACITY.

OIL ENGINE UNITS

1—650 Kw. Revolving Field E. T. Alternator, 60-cycle, 3-phase, 480-v., D. C. to Vertical Gas Engine.

2—300 Kw., 60-cycle, 3-phase, Revolving Field E. T. Alternators, D. C. to Vertical Diesel Engines.

1—400 Kva., 60-cycle, 3-phase, Revolving Field Alternator, D. C. to Horizontal Diesel Engine.

2—300 Kw., E. T. Revolving Field Alternators, 250-v., D. C. to Vertical Diesel Engines.

SEVERAL BELTED GAS AND CRUDE OIL ENGINES RANGING IN SIZE FROM 100 TO 800 KW.

CONDENSERS

2—8000 Sq. Ft. Wheeler, Admiralty type, Surface Condensers, without Auxiliaries.

2—5750 Sq. Ft. Worthington, complete with all Fittings and Auxiliaries.

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Ready for Immediate Delivery

ALTERNATING CURRENT, DIRECT CONNECTED SETS

1—450 Kva., 3-phase, 60-cycle, 550-volt Crocker-Wheeler Generator, direct connected to horizontal cross compound Erie City Lentz engine, size 15½ x 26 x 18, 200 r.p.m. Complete with all parts ready to operate; practically new. Installed in 1912.

1—240-Kw., 3-phase, 60-cycle, 600-volt, can be reconnected to 2300 volts or lower voltage, 200 r.p.m., General Electric, type ATB, direct connected to horizontal Harrisburg Ideal Tandem Compound Engine.

1—300-Kw., 3-phase, 25-cycle, 380 volts, General Electric, revolving field, type ATB Generator, 107 r.p.m., to horizontal cross compound Brown Engine, in splendid condition.

DIRECT CURRENT DIRECT CONNECTED SETS

1—300-Kw., 550-volt, can be reconnected to 250 volts, General Electric, 8-pole, form H Generator, amperes 545, 105 r.p.m., full commutator, direct connected to horizontal cross compound Green Engine, splendid condition.

DIRECT CURRENT—3 WIRE TURBINE UNIT

1—150-Hp., De Laval Turbine, direct-connected to 100-Kw., 125/250 volts direct current Sprague Generator.

DIRECT CONNECTED PRODUCER GAS ENGINE SETS

1—170-Kw., 180-r.p.m., 6-pole, General Electric Generator, direct connected to vertical Rathbun-Jones Gas Engine; size of cylinder, 19½ x 19

2—550-Kw., 3-phase, 60-cycle, 480-volt, 171-r.p.m., General Electric revolving field Generators, direct connected to horizontal Bethlehem Steel Gas Engines; size of cylinders, 26 x 32; first-class condition.

LARGE ALTERNATING CURRENT MOTORS

1—300-Hp., 3-phase, 60-cycle, 550-volt, 600 r.p.m., Crocker Wheeler motor.

3—150-Hp., 3-phase, 60-cycle, 550-volt, 720 r.p.m. type M, new 40-degree rise, General Electric, slipring motors.

2—150-Hp., 3-phase, 60-cycle, 220-volt, 586 r.p.m., Westinghouse, type CS motors.

1—200-Hp., 3-phase, 60-cycle, 220-volt, 600 r.p.m., new, Western Electric, form M motor.

LARGE ALTERNATING CURRENT BELTED GENERATORS

1—300-Kw., 3-phase, 60-cycle, 2300-volt Allis Chalmers revolving field 600 r.p.m., 3 bearing generator, 35 degree rated machine, good for 400 Kva.

1—200-Kw., 3-phase, 60-cycle, 2300-volt, type ATB, General Electric, 3 bearing generator, 600 r.p.m.

2—100-Kw., 3-phase, 60-cycle, 2300-volt, 900 r.p.m. General Electric, type ATB generator.

DIRECT CURRENT BELTED GENERATOR

1—450-Kw., 250-volt, 8-pole, C. & C. direct current generator.

LARGE ALTERNATING CURRENT GENERATORS FOR WATERWHEEL DRIVE OR SYNCHRONOUS MOTOR FOR DIRECT CONNECTION

2—550-Kw., 3-phase, 60-cycle, 480-volt, 171-r.p.m., General Electric, revolving field, 85% P.F.

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1—26-in. x 48-in. Heavy Duty Allis Corliss Engine, in splendid shape.

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MOTORS—2-Phase, 60-Cycle, 220-Volt

1	2	G. E.	KQ	1200	U	Stock
1	7½	Fidelity	AP	1750	U	6/20
3	15	Westghse.	CS	1800	N	Stock
2	20	Allis-Chal.	AN	1800	N	Stock
1	20	G. E.	M	1800	U	Stock
4	25	Allis-Chal.	AN	1800	N	Stock
2	40	Allis-Chal.	AN	1800	N	Stock
4	50	Allis-Chal.	AN	1800	N	Stock
1	100	Allis-Chal.	AN	1800	N	Stock
13	2	C.-W.	.....	1200	N	Stock
9	½	C.-W.	.....	1800	U	Stock
3	1	Wagner	.....	1800	U	Stock
2	1	Wagner	.....	1140	U	Stock
25	2	C.-W.	.....	1200	U	Stock
6	3	C.-W.	.....	1200	U	Stock
4	3	C.-W.	.....	1800	U	Stock
1	7½	C.-W.	.....	1200	U	Stock
1	10	C.-W.	.....	1200	U	Stock
2	15	C.-W.	.....	1200	U	Stock
2	15	R.-M.	.....	1200	U	Stock
2	15	Westghse.	.....	1200	U	Stock
1	15	Westghse.	.....	1800	U	Stock
1	15	R.-M.	K	900	U	Stock
1	125	Westghse.	CCL	450	U	Stock
1	150	Westghse.	CCL	514	U	Stock

MOTORS—2-Phase, 60-Cycle, 550-Volt

2	60	W. E.	KQ	1200	N	Stock
4	75	W. E.	KQ	1200	N	Stock
2	150	Westghse.	CW	600	N	Stock
1	30	G. E	IQ3Brg.	514	U	Stock
1	115	Westghse.	CCL	400	U	Stock

MOTORS—3-Phase, 60-Cycle, 220 and 440-Volt

1	1	G. E.	KT	1800	U	Stock
1	1	Allis-Chal.	AN	1200	N	Stock
1	1	Allis-Chal.	AN	1800	N	Stock
1	2	Allis-Chal.	AN	1200	N	Stock
2	2	Allis-Chal.	AN	1800	N	Stock
2	2	Allis-Chal.	AN	1200	N	Stock
2	3	Allis-Chal.	AN	1200	N	Stock
4	3	Allis-Chal.	AN	1800	N	Stock
2	3	Allis-Chal.	AN	1200	N	Stock
3	5	Allis-Chal.	AN	1200	N	Stock
2	5	Allis-Chal.	AN elev.	770	N	Stock
8	5	Allis-Chal.	AN	1800	N	Stock
2	5	Allis-Chal.	AN	1200	N	Stock
4	7½	Allis-Chal.	AN	1200	N	Stock
1	7½	G. E.	KT	1200	U	Stock
3	10	Allis-Chal.	AN	900	N	6/28/20
4	10	Allis-Chal.	AN	1200	N	Stock
2	10	W. E.	KT	1200	U	Stock
3	15	Allis-Chal.	AN	1200	N	Stock
2	15	Allis Chal.	AN	900	N	Stock
1	15	Allis-Chal.	ANY	900	N	Stock
1	15	Allis-Chal.	ANY	1200	N	Stock
2	15	Allis-Chal.	AN	900	N	Stock
1	20	F.-M.	KBV	1200	N	Stock
2	20	Allis-Chal.	AN	1200	N	Stock
1	20	Allis-Chal.	ANY	1200	N	Stock
2	20	Allis-Chal.	ANY	900	N	Stock
1	20	Allis-Chal.	AN	900	N	Stock
1	20	Century in rest start		865	N	Stock
1	25	Allis-Chal.	AN	1200	N	Stock
6	25	Allis-Chal.	AN	900	N	Stock
1	25	Westghse.	CS	685	U	Stock
1	25	G. E.	KT	900	U	Stock
3	30	Allis-Chal.	ANY	900	N	Stock
1	30	Allis-Chal.	AN	1200	N	Stock
2	30	Westghse.	CCL	900	U	Stock
1	30	Allis-Chal.	AN	900	N	Stock
1	35	Westghse.	CS	900	U	Stock
1	35	C.-W.	Sq. cage	860	N	Stock
1	40	Westghse.	CW	1200	N	Stock
4	40	Allis-Chal.	AN	1200	N	Stock
3	40	Allis-Chal.	ANY	900	N	Stock
1	40	Allis-Chal.	AN	900	N	Stock
1	45	G. E.	K	720	N	Stock
1	50	Allis-Chal.	AN	720	N	Stock
1	50	Allis-Chal.	AN	1200	N	Stock
2	50	Allis-Chal.	AN	1800	N	Stock
1	50	Allis-Chal.	ANY	900	N	Stock
1	60	G. E.	K	1200	N	Stock
1	75	Allis-Chal.	AN	900	N	Stock
1	75	G. E.	K	1200	N	Stock
1	150	Westghse.	CW	600	N	Stock
1	250	Westghse.	CW	600	N	Stock

MOTORS—3-Phase, 60-Cycle, 550-Volt

1	5	Allis-Chal.	AN	1800	N	Stock
3	7½	Allis-Chal.	AN	1800	N	Stock
3	15	Westghse.	CS	1800	N	Stock
2	20	Allis-Chal.	AN	1800	N	Stock
1	20	G. E.	M	1800	U	Stock
4	25	Allis-Chal.	AN	1800	N	6/28/20
2	40	Allis-Chal.	AN	1800	N	Stock
4	50	Allis-Chal.	AN	1800	N	6/28/20
1	75	G. E.	I	1200	N	6/28/20
2	100	W. E.	KT	1800	N	Stock
1	100	Allis-Chal.	AN	1800	N	Stock
2	150	Westghse.	CW	600	N	Stock
1	115	Westghse.	CCL	450	U	Stock
1	125	Westghse.	CCL	600	U	Stock
1	150	Westghse.	CCL	600	U	Stock
1	175	Westghse.	CCL	415	U	Stock

MOTORS—3-Phase, 60-Cycle, 2200-Volt

2	150	Westghse.	CW	600	N	Stock

MOTOR—Single Phase, 25-Cycle

No.	Hp.	Make	Type	Volts	R.p.m.		Avail.
1	¼	Century	R.S.	110-220	750	N	Stock

MOTORS—2-Phase, 25-Cycle, 220-Volt

No.	Hp.	Make	Type	R.p.m.		Avail.
1	30	Allis-Chal	AN	750	U	Stock
2	50	Westghse.	CW	250	N	Stock
1	125	G. E.	IQ3Brg	214	U	Stock

MOTORS—3-Phase, 25-Cycle, 220 and 440-Volt

1	1	Westghse.	CSA	750	N	Stock
3	1	Allis-Chal.	AN	1500	N	Stock
1	2	Allis-Chal.	AN	1500	N	Stock
2	3	Allis-Chal.	AN	750	N	Stock
2	3	Allis-Chal.	AN	1500	N	Stock
2	5	Allis-Chal.	AN	1500	N	Stock
2	5	Allis-Chal.	AN	750	N	Stock
3	7½	Westghse.	CS	750	N	Stock
1	7½	Allis-Chal.	AN	750	N	Stock
2	10	Allis-Chal.	AN	750	N	Stock
1	15	Allis-Chal.	AN	750	N	Stock
1	15	G. E.	K	300	N	Stock
4	20	Allis-Chal.	AN	750	N	Stock
1	30	G. E.	K	500	N	Stock
2	40	W. E.	KT	725	N	Stock
1	50	Westghse.	CW	250	N	Stock
4	50	W. E.	KT	725	N	Stock
1	150	W. E.	KT	750	N	Stock
2	150	W. E.	M	500	N	Stock

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Power Engineers and Dealers in Power Equipment of Any Description

A.C., 60-CYCLE, 3-PHASE 220-440 VOLTS

1—150-hp., 720 r.p.m., General Electric Squirrel Cage Motors; used.
2—75-hp., 900 r.p.m., Western Electric Motors complete; new.
2—50-hp., 1800 r.p.m., Allis-Chalmers Motors complete; used.
7—50-hp., 900 r.p.m., Fairbanks-Morse Type B Motors complete; used.
2—50-hp., 900 r.p.m., W. E. Motors complete; used.
2—40-hp., 1200 r.p.m., Wagner Motors complete; used.
6—30-hp., 680 r.p.m., Allis-Chalmers Motors complete; used.
3—30-hp., 1800 r.p.m., G. E. Motors complete; used.
1—25-hp., 900 r.p.m., Westinghouse Type C Motors complete; used.
3—20-hp., 1200 r.p.m., G.E. Motors complete; used.
5—20-hp., 900 r.p.m., G. E. Motors complete; used.
2—20-hp., 1800 r.p.m., G. E. Motors complete; used.
1—20-hp., 680 r.p.m., Allis-Chalmers Motors complete; used.
4—15-hp., 1200 r.p.m., G. E. 50 degree Motors complete; new.
3—10-hp., 1800 r.p.m., G. E. 50 degree Motors complete; new.
4—10-hp., 1200 r.p.m., G. E. 50 degree Motors complete; new.
2—10-hp., 1800 r.p.m., Allis-Chalmers Motors complete; new.
2—10-hp., 1200 r.p.m., Allis-Chalmers Motors complete; new.
2—10-hp., 1800 r.p.m., Fairbanks-Morse Type B Motors complete; new.
1—10-hp., 1800 r.p.m., G. E. Motor complete; used.
4—7½-hp., 1800 G. E. 50 degree Motors complete; new.
4—7½-hp., 1200 r.p.m., G. E. 50 degree Motors complete; new.
2—7½-hp., 1200 r.p.m., Allis-Chalmers Motors complete; new.
1—7½-hp., 1800 r.p.m., G. E. Motor complete; used.
5—5-hp., 1800 r.p.m., G. E. Motor complete; used.
6—5-hp., 1800 r.p.m., G. E. Motor complete; new.
6—5-hp., 1200 r.p.m., G. E. Motor complete; new.
6—3-hp., 1800 r.p.m., G. E. 50 degree Motors complete; new.
6—3-hp., 1200 r.p.m., G. E. 50 degree Motors complete; new.
11—2-hp., 1800 r.p.m., Crocker-Wheeler 50 degree Motors complete; new.
6—2-hp., 1800 r.p.m., G. E. 50 degree Motors complete; new.
6—2-hp., 1200 r.p.m., G. E. 50 degree Motors complete new.
1—2-hp., 1200 r.p.m., Jenny Slip Ring Motors complete; used.

A.C., 60-CYCLE, SINGLE PHASE, 110-220 VOLTS

5—5-hp., 1750 r.p.m., Bell Motor complete; new.
11—5-hp., 1750 r.p.m., Peerless Motors complete; new.
6—5-hp., 1200 r.p.m., Peerless Motors complete; new.
15—3-hp., 1750 r.p.m., Peerless Motors complete; new.
6—3-hp., 1200 r.p.m., Peerless Motors complete; new.
2—3-hp., 900 r.p.m., Peerless Motors complete; new.
5—3-hp., 1800 r.p.m., Bell Motors complete; new.
2—3-hp., 1200 r.p.m., Bell Motors complete; new.
18—2-hp., 1750 r.p.m., Peerless Motors complete; new.
6—2-hp., 1200 r.p.m., Peerless Motors complete; new.
5—2-hp., 1750 r.p.m., Bell Motors complete; new.
2—2-hp., 1200 r.p.m., Bell Motors complete; new.
3—1½-hp., 1750 r.p.m., Peerless Motors complete; new.
3—1-hp., 1200 r.p.m., Peerless Motors complete; new.
5—1-hp., 1750 r.p.m., Bell Motors complete; new.

A.C., 60-CYCLE, SINGLE PHASE, 110-220 VOLTS

2—1-hp., 1200 r.p.m., Bell Motors complete; new.
40—½-hp., 1750 r.p.m., G. E. Motors complete; new.
20—½-hp., 1750 Robbins-Meyers Motors complete; new.
2—½-hp., 1150 r.p.m., Peerless Motors complete; new.

D.C., 110 VOLT MOTORS

1—220-hp., 300 r.p.m., Shunt Crocker-Wheeler Motor only; used.
1—100-hp., 300 r.p.m., Shunt Crocker-Wheeler Motor only; used.
1—15-hp., 150-450 r.p.m., Shunt Interpole Sturtevant Variable Motor; used.
1—10-hp., 700 r.p.m., G. E.; used.
1—10-hp., 50 r.p.m., Fairbanks-Morse; new.
1—7½-hp., 1650 r.p.m., Eddy; new.
1—5-hp., 1800 r.p.m., Imperial; used.

D.C., 220 VOLT MOTORS

1—40-hp., 360 r.p.m., G. E.; used.
1—25-hp., 640 r.p.m., C. & C.; used.
1—15-hp., 1050 r.p.m., C. & C.; used.
1—7½-hp., 950 r.p.m., Robbins-Meyers; used.
1—7½-hp., 1150/1500 r.p.m., Sprague; used.
1—hp., 1750 r.p.m., Robbins-Meyers; used.

D.C., 500 VOLT MOTORS

1—10-hp., 800 r.p.m., Crocker-Wheeler; used.
1—10-hp., 800 r.p.m., G. E.; used.
1—7½-hp., 800 r.p.m., W. E.; used.
1—7½-hp., 1950 r.p.m., Richmond; used.
1—7½-hp., 1050 r.p.m., Westinghouse; used.
2—5-hp., 1950 r.p.m., Crocker-Wheeler; used.
3—5-hp., 1100 r.p.m., Crocker-Wheeler; used.
2—5-hp., 1800 r.p.m., G. E.; used.
2—1-hp., 1200 r.p.m., G. E.; used.

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Large quantity of short boards and 2 x 4 at very attractive prices. Especially suitable for air ducts.

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Made of black iron plate. Shells ¼ in. thick and heads 5/16 in. thick. Double rivetted and tested to 200 lb. pressure.
250— 5 ft. x 24 in., 120 gal. capacity
250— 5 ft. x 30 in., 180 gal. capacity
250— 5 ft. x 36 in., 210 gal. capacity
250— 6 ft. x 42 in., 430 gal. capacity
250— 6 ft. x 48 in., 525 gal. capacity

HEATING BOILERS
Steam and hot water made by Gurney McLain and others. All sizes and ratings from 2,100, 5,500 sq.ft. radiators.

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Several makes and sizes. For heating water for storage tanks.

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Steam and hot water, standard makes 1 to 8, columns 38 in., 1 to 23 sections.

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Check, relief, gate, air, steam and reducing.

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In large quantities.
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Bends, Ties, Traps and Clean-out Plugs. All sizes from 2 to 6 in.
Ranges, makes such as Wetter & Sons.
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Galvanized Range Boilers, all sizes and various capacity from 66 to 120 gal.
Hot Air Furnaces, suitable to miners' dwellings, bath houses, etc.
Heating Stoves, Ventilators, Refrigerators, etc.
Slop Sinks, cast iron, enameled, sizes 15 x 20 in., 18 x 22 in., 20 x 22 in.
Showers for Bath Houses, rough cast brass and nickel plate of various kinds.

ELECTRICAL EQUIPMENT
TRANSFORMERS

WESTINGHOUSE, TYPE "P"

Kva.	H. T.	L. T.	Cycle
1	2200	110-220	50-140
5	2200	110-220	60
7½	2200	110-220	50-140
10	2200	110-220	60
15	2200	110-220	60

"PITTSBURGH"

Kva.	H. T.	L. T.	Cycle
2	2200	110-220	60
5	2200	110-220	50-133
15	2200	110-220	50-133
15	2200	110-220	60
20	2200	110-220	60
25	2200	110-220	60
375	2200-11,000	2300	60
400	2200-11,000	2300	60

"GENERAL ELECTRIC," Type H

Kva.	H. T.	L. T.	Cycle
20	2200	110-220	60
25	2200	110-220	60
2	3300	122-244	60
7½	3300	122-244	60
10	3300	122-244	60
10	1560-3120	115-230	60
15	3300	122-244	60
25	3300	122-244	60
30	3300	122-244	60
37½	1560-3120	115-230	60

"GENERAL ELECTRIC" Constant Current Type "RO"

Kva.	H. T.	L. T.	Cycle	Amp.
4	2300	....	60	6.6
8	2300	....	60	6.6

"MOLONEY," Type "HE"

Kva.	H. T.	L. T.	Cycle
2	3300	110-220	60
7½	3300	110-220	60
7½	1150-2300	115-230	60
15	1150-2230	110-220	60
15	1150-2300	115-230	60
15	1650-3300	115-230	60
15	1650-3300	120-240	60
20	4000	110-220	60

"PACKARD," Type "A" 3-K., 60-Cycle, P.V. 3300-Amp., 6.6 Transformer 1674, Adjuster Coil A W 1674

Kva.	H. T.	L. T.	Cycle
15	3300	115-230	60
100	2200	110-220	60

"WAGNER," Type "HE"

Kva.	H. T.	L. T.	Cycle
15	2200	110-220	60

COMPLETE PUMPING STATION

3—Circular Redwood Tanks, 44 ft. in diameter, with 18-ft. staves, covered, capacity of each about 200,000 gallons. Elevation of water level when the tanks are full is 55.6.

PUMPING EQUIPMENT

1—Worthington Centrifugal Pump, 750-g.p.m., 8-in. suction, 6-in. discharge, driven by G. E. motor, 100-hp., 1760-r.p.m.
1—Allis-Chalmers Centrifugal pump, 1000-g.p.m., 6-in. discharge, 6-in. suction, 160-ft. head; driven by Fairbanks-Morse 75-hp., 1750-r.p.m.
1—Platt Iron Works Centrifugal Pump, 1000-g.p.m., 160-ft. head, 6-in. suction, 6-in. discharge, driven by Fairbanks-Morse motor, 75-hp., 1750-r.p.m.
1—6 x 6 Van Blerck Motor, with Leece-Neidle Electric Starting Equipment, direct-connected to pump. To be used should electric current fail.
1—Venturi Meter (Builders Iron Foundry), 8-in. x 3½ in. capacity, 1.4 m.g.d.

At this station are the controls for the electric service in Camp Stuart and the Embarkation Hospital. There is also a Wallace-Tiernan solution chlorine apparatus used for chlorinating all water passing through the station.

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Adjusters	**Arresters**	**Break Arms**	**Cross Arms**	**Brace Arms**	**Brackets**	**Bolts**	**Bases**
Cutter Boxes	**Conduiets**	**Lamp Cord**	**Cleats**	**Clamps**	**Fixtures**	**Insulators**	**Lamps**
Cutouts	**Plugs**	**Sockets**	**Switches**	**Wire**	**Poles**		

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2—200-kw. **Crocker-Wheeler Generators,** direct connected to Buckeye engine, 500-volt D.C. or 250-volt D.C. Complete with panels, meters, rheostats, etc.
1—15-kw., 125-volt, 120 amp. **Westinghouse Generator.** Complete with panel, meters, etc., 1 extra armature.
1—20-kw., 125-volt **Lighting Set,** 160 amp. Complete with panels, meters, etc. The 15 and 20-kw. sets are equipped with Westinghouse standard engines.
2—150-hp. **Bullock Motors,** 500-volt, 750 r.p.m. Complete with slide rail bases, pulleys and starters.
2—200-hp., 690 r.p.m. **A. C. Motors,** 2200-volt. Complete with slide rail base and pulleys and starters. Out bored bearings. All for immediate delivery, F.O.B. cars Pittsburgh.

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1—350 hp. Erie City water tube boiler; new fronts, grates and trimmings; built for 150 lb. working pressure; offered subject Hartford Insurance acceptance; immediate shipment, located Lakeside, Nebraska.

2—Steel stacks, 56 in. diameter by 90 ft. high; dismantled and ready for shipment.

3—72 in. x 16 in. return tubular boilers; at present set in battery, with breeching, piping and valves; special fronts, and shaker grates; these boilers can be set separately. Located Omaha, Nebraska.

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1—9000-Kw., 6600 or 11500-Volt, 3-Phase, 60-Cycle

GENERATOR

directly connected to G. E. Turbine

This unit is of a vertical type mounted on a surface condenser having all auxiliary equipment complete, including duplicate high pressure and low pressure oil pumps, filtering apparatus, etc., and one spare step bearing, available for immediate service. Inspectable at Charleston, W. Va.

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1—400 hp., G. E. Slip-ring, 435 r.p.m., 2200-v. (will be sold with mine hoists only).
1—250 hp. Allis-Chalmers, 550-v., 410 r.p.m.
2—200 hp. Westinghouse, sq. cage, 580 and 870 r.p.m.
3—100 hp. Crocker-Wheeler, 1800 r.p.m.
3—50 hp., 600 and 720 r.p.m.
1—50 hp. Fairbanks-Morse, slip-ring, 1200 r.p.m.
1—40 hp. Crocker-Wheeler, 865 r.p.m.
3—35 hp. Crocker-Wheeler, 865 r.p.m.
5—25 hp., 1200 r.p.m. and 900 r.p.m.
1—20 hp., 1720 r.p.m. Crocker-Wheeler.
8—15 hp., 1130 r.p.m. and 900 r.p.m.
6—10 hp., 1130 r.p.m
10—5 hp., 1130 r.p.m.

1-PHASE, 110/220 V.

2—1/6 hp. Century, 1165 r.p.m.
4—¼ hp. Century and Wagner, 1165 r.p.m.
2—¼ hp., 1750 r.p.m.
6—½ hp. Century and Wagner, 1165 r.p.m.
2—1/3 hp. Kimble, variable speed.
4—¾ hp. Kimble, variable speed.
6—1 hp. Century, 1165 r.p.m.
10—1½ hp. Century, 1165 r.p.m.
3—2 hp. Century, 1165 and 1750 r.p.m.
3—3 hp. Century, 1750 r.p.m.
2—3½ hp. Century, 1165 r.p.m.
1—7½ hp. Wagner, 1140 r.p.m.

2-PHASE, 220/440 V.

4—1 hp., 1710 r.p.m.
10—5 hp., 1130 r.p.m.
8—7½ hp., 1130 and 1750 r.p.m.
12—10 hp., 1130 r.p.m.
6—15 hp., 1130 and 850 r.p.m.
1—200 hp., 580 r.p.m. Westinghouse, Type C.
1—200 hp., 870 r.p.m.

MOTOR GENERATOR SETS

1—40 Kw., 250-v. Westinghouse Generator, 1200 r.p.m., and 60 hp. Westinghouse synchronous motor, with switchboard and starting equipment.
1—100 Kw., 250-v. Westinghouse, to 150 hp. Westinghouse, Type C, 220-v., squirrel cage motor.

DIRECT CONNECTED SETS

2—75 Kw. Westinghouse, 125-v., D.C. to Erie Ball latest enclosed engines, piping, parts, etc.
1—30 Kw., 125-v. Western Electric, to Buckeye piston valve engine.
1—150 Kw., 250-v., D.C. Gen. Elec. Turbo-Generator unit, 140 lb. non-condensing.
Also larger units.

ELECTRIC HOISTS—NEW

10—15 hp., 230-v., D.C. double drum, side by side with 12 x 15 drums, to carry 6000 ft. ½-in. rope.
1—400 hp. General Electric slip-ring, 5 ft. dia. x 4 ft. wide drum carriers, 6000 ft. 1-in. rope. All attachments complete.

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1—2¾ x 20 Wm. Todd Duplex Horizontal Pump, 100 gal. capacity, 3000 lb. pressure, motor driven.

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1—"HUNT" No. 2818 COAL CONVEYOR COMPLETE; Consisting of:

615 lineal ft. Conveyor Chain, with sheet steel buckets.

1 Pawl type belt driven driver.

215 lineal ft. Conveyor Track, on double rail stands.

225 lineal ft. Conveyor Track, on stands.

16 Dumpers.

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All necessary accessories for a complete coal conveying outfit. Capacity approx. 50 tons per hour. Installed 1917; used but little and in excellent condition.

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60 ft. latticed steel boom (brand new). Propelling engine, assembled and ready for operation.

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Thoroughly overhauled and in first-class operating condition.

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Diesel Oil Engines, Gas Engines, Generators

AMERICAN DIESEL ENGINES

1—170 BHP., vert., 3 cyl., belted.
1—170 BHP., vert., 3-cyl., coupled to
1—150 Kva., 3-phase Generator.
2—225 BHP., vert., 3 cyl., belted.
2—225 BHP., vert., 3-cyl., coupled to
2—150 Kw., D.C. Generators.
1—225 BHP., vert., 3 cyl., coupled to
1—200 Kva., 3-phase, 60-cy., 2300-v. Generator.
2—450 BHP., 6 cyl., each coupled to 3-phase, 60-cycle, A.C. Generator.
1—100 BHP., vert., 2-cyl., oil, belted to
1—85 Kva., 3-phase, 60-cy., 2300-v., 900 r.p.m. Generator.
1—75-80 BHP. horiz., 2-cyl., oil belted.
1—35 BHP., horiz., 2 cyl., oil; new.
2—25 BHP., F. M., Type "Y," oil, new.
1—20 BHP. F. M., Type "Y," Oil Engine.
1—150 BHP., 3 cyl., vert. Gas Engine, d. c. to
1—100 Kw., 220-v., D.C. Generator.
1—100 BHP., vert., 3 cyl. Gas Engine, d. c. to
1—65 Kw., 125/250-v., 3-wire Generator.
1—100 BHP., vert. Gas Engine, d. c. to
1—65 Kw., 125-v., D.C. Generator.

All guaranteed in good operating condition before shipment.

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COMPRESSORS
1—16 x 16 x 24-in. Ingersoll RC type, 530 ft.
8 x 9 Belt Driven Duplex International.
1—Peerless Duplex Steam, 10 x 13, air cyl. 10 x 12 steam, 125 lb. air.

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Several D.C. and A.C.

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2—54-in. x 12-ft. Phoenix with stacks.
1—84-in. x 18-ft. Coatesville, 100-lb.

(WATER TUBE)
1—150-hp. B. & W., 150-lb.
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2—231-hp. Edge Moor, 150-lb.

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1—100-hp. De La Vergne, type FH.
1—200-hp. De La Vergne, type FH.

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1—190-hp. Rathbun-Jones, three-cylinder.
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14 x 32 Watts-Campbell Corliss engine.
150-hp. Erie City "Tangye" type engine.
11 x 14 Syracuse straight line automatic, 100 hp.
115 ft., 22 in. diameter, ¼ in. plate.
5—Smoke Stacks 38 in. diameter at bottom, 50 in. at top, 55 ft. high, 5/16 in. plate.
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1—45 H.P. **Marine Type Boiler**, butt strapped, double riveted, 115 lb. steam pressure in Ohio. Complete with all necessary fittings and stack diameter, 24 in. and 50 ft. high.
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1000 Heine	200 lb. (new)	27-250 B &W 150 lb.
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1 517 Stirl.	150 lb.	2-150 Heine 150 lb.
1-400 Stirl.	150 lb.	2-84x18 HRT 100 lb.
1-275 Stirl.	150 lb.	4-72x18 HRT 175 lb.
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30 ton of rail—12, 16, 20, 25 and 35 lb.
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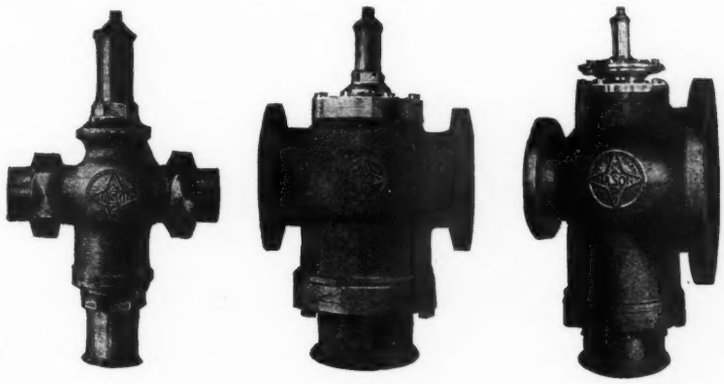

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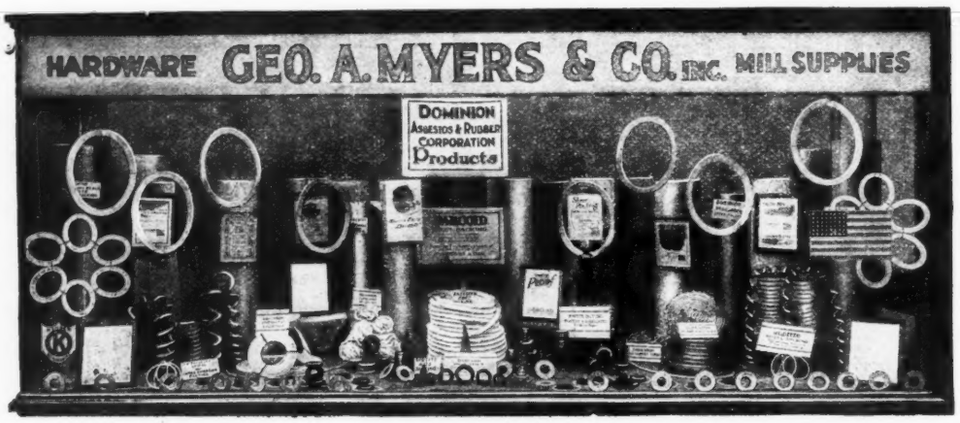

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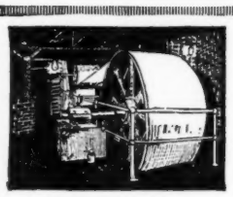

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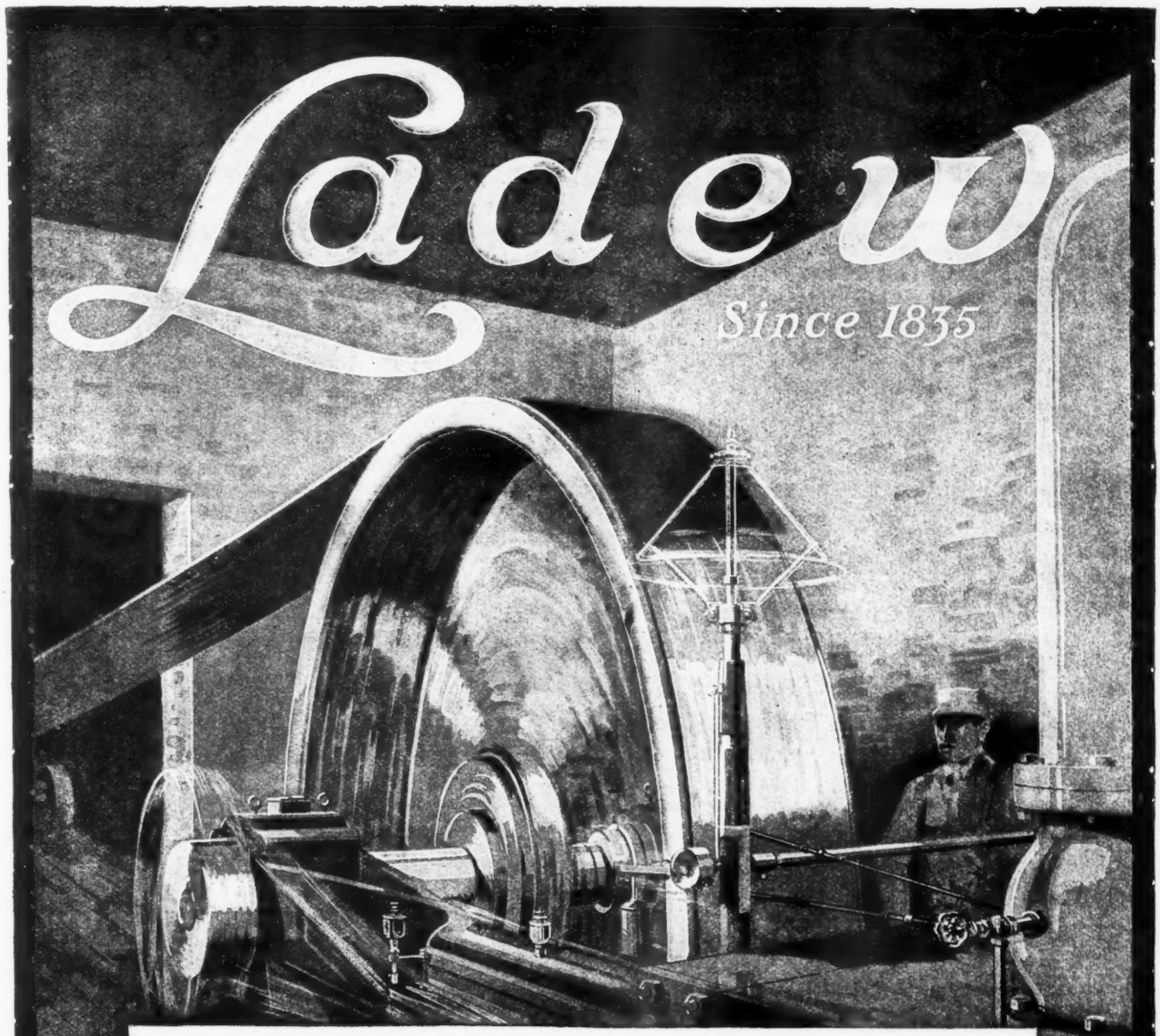

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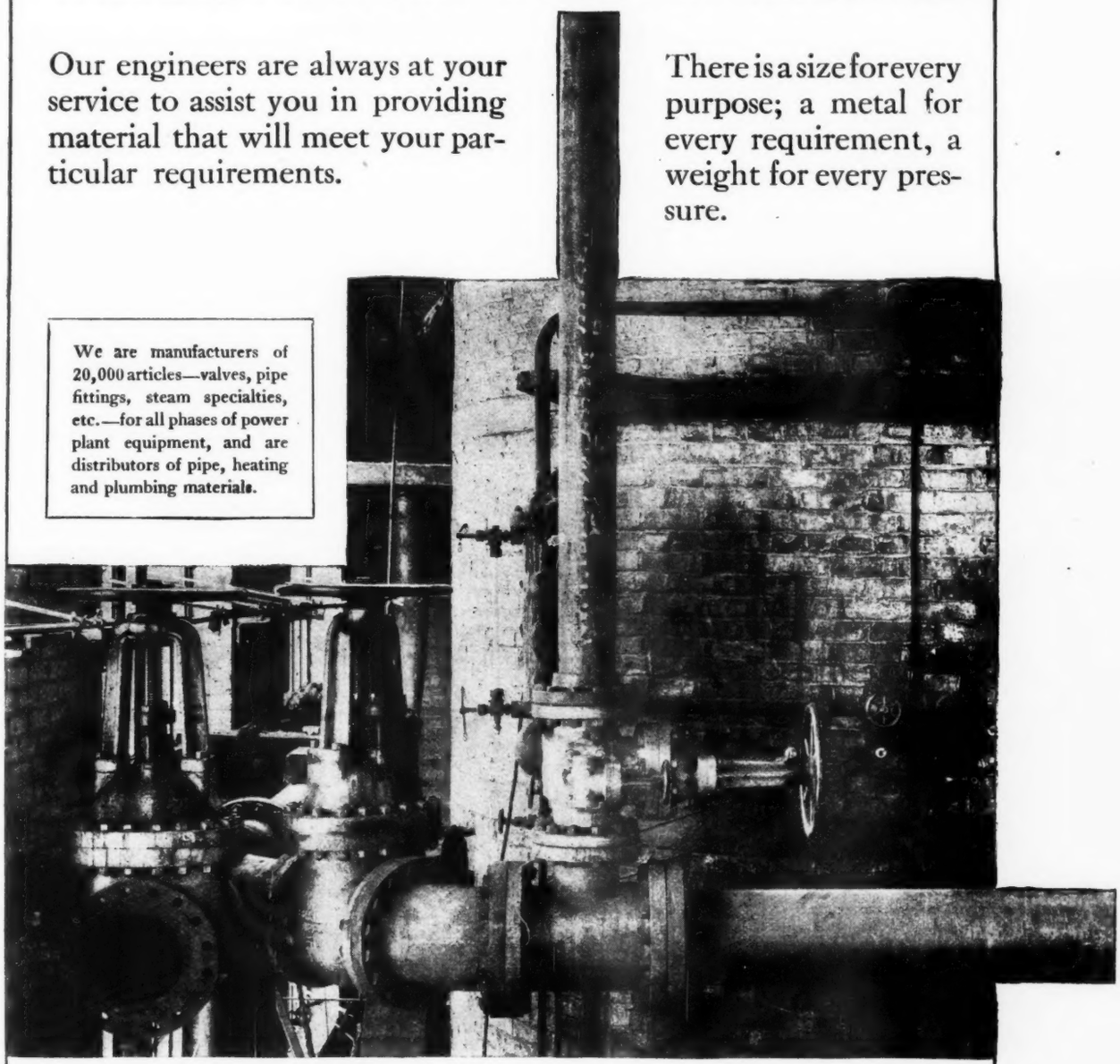

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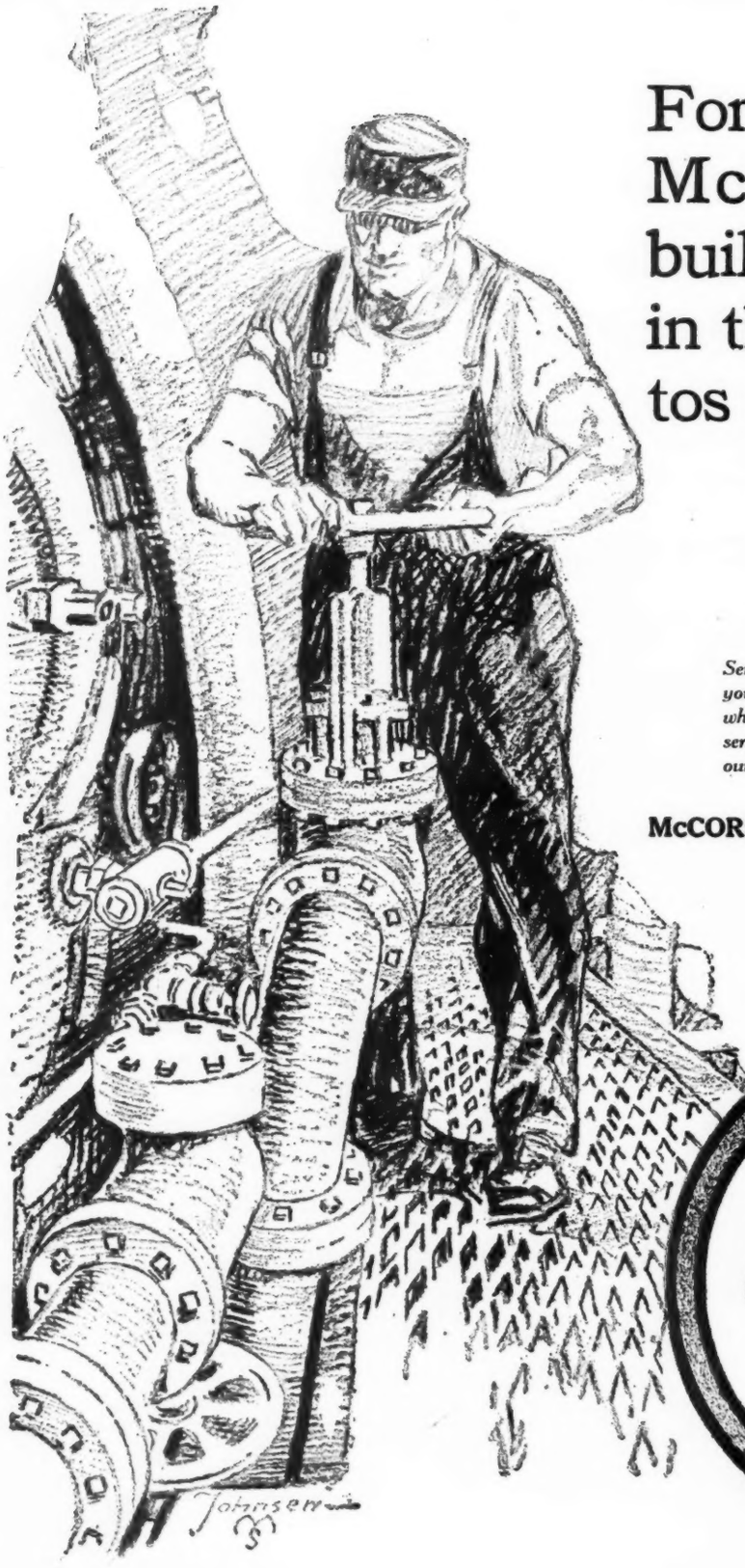

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Send your name and address—also pipe size of your most troublesome fitting or union. State whether standard or extra heavy and nature of service. We will send you a sample McKim and our steam gasket catalog.

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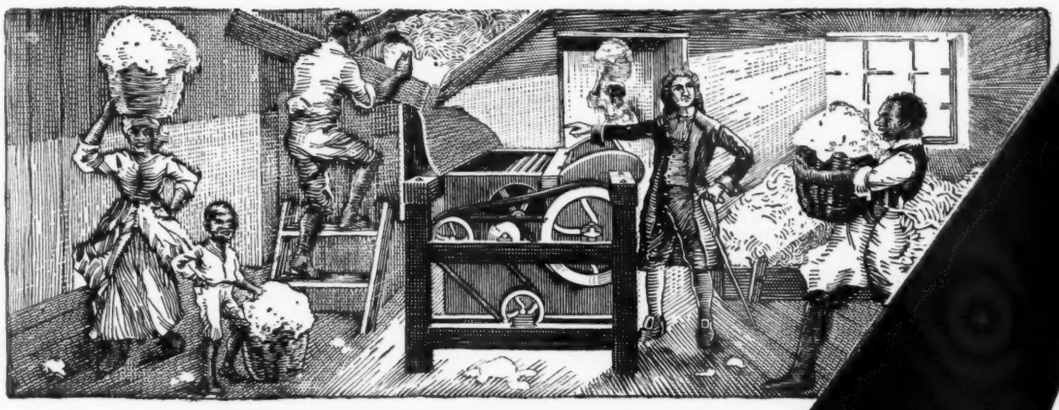

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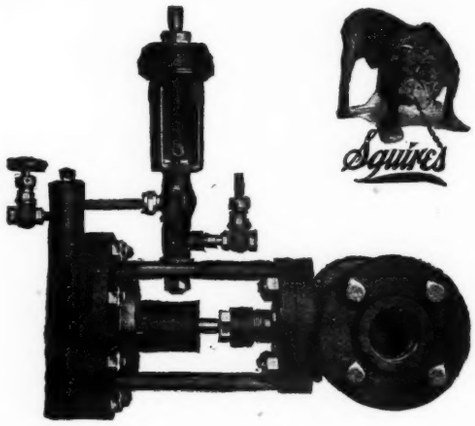

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You protect your own interests when you install New Bedford Valves. Longest life—least attention. It's in the material and workmanship.

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For Safe Plant Operation

SCHUTTE Automatic Emergency Stop and Check Valves, Triple Duty Type eliminate serious and possibly fatal accidents due to reversal of steam flow into a damaged boiler or a disastrous pipe explosion from any cause.

They will instantly cut out a damaged boiler or shut off the steam flow entirely in case a break occurs in any steam pipe.

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Made in Angle Globe or Inverted Patterns.

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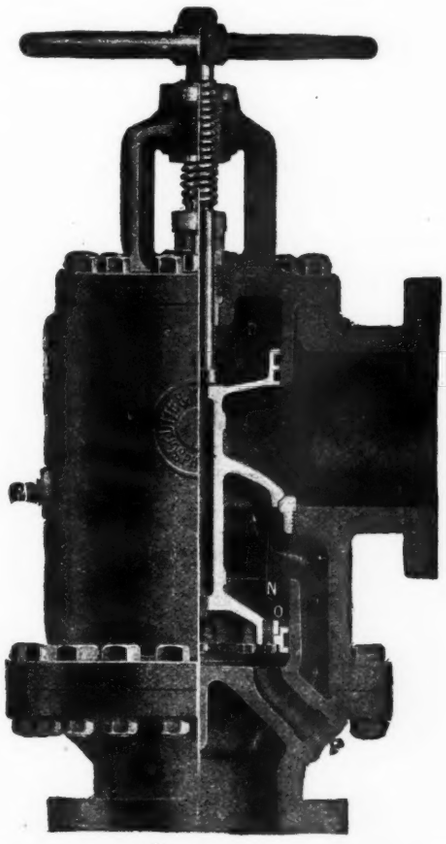

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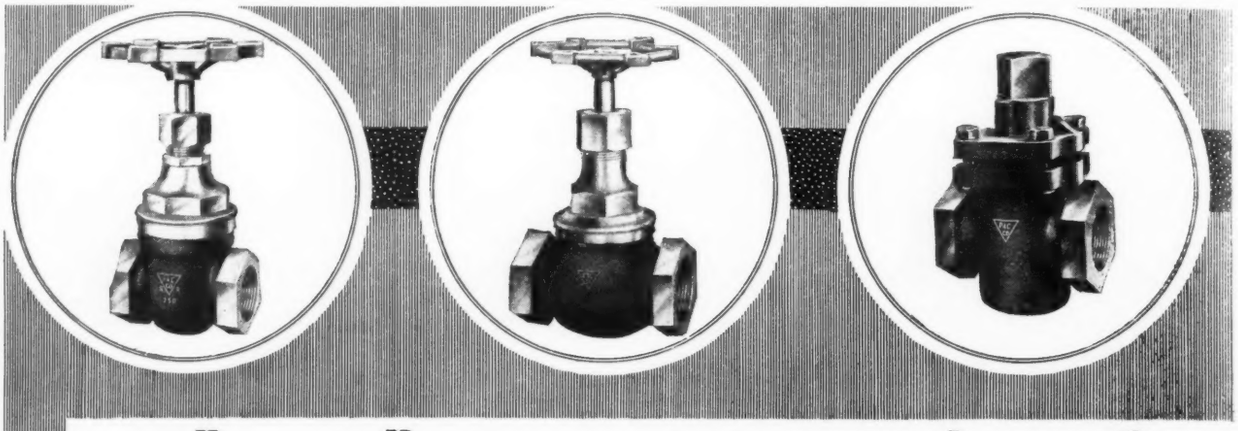

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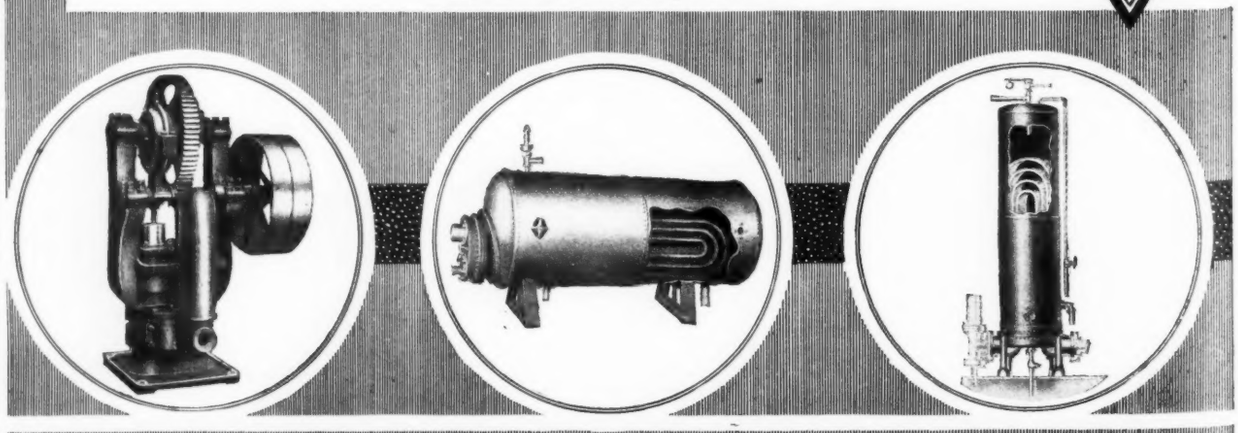

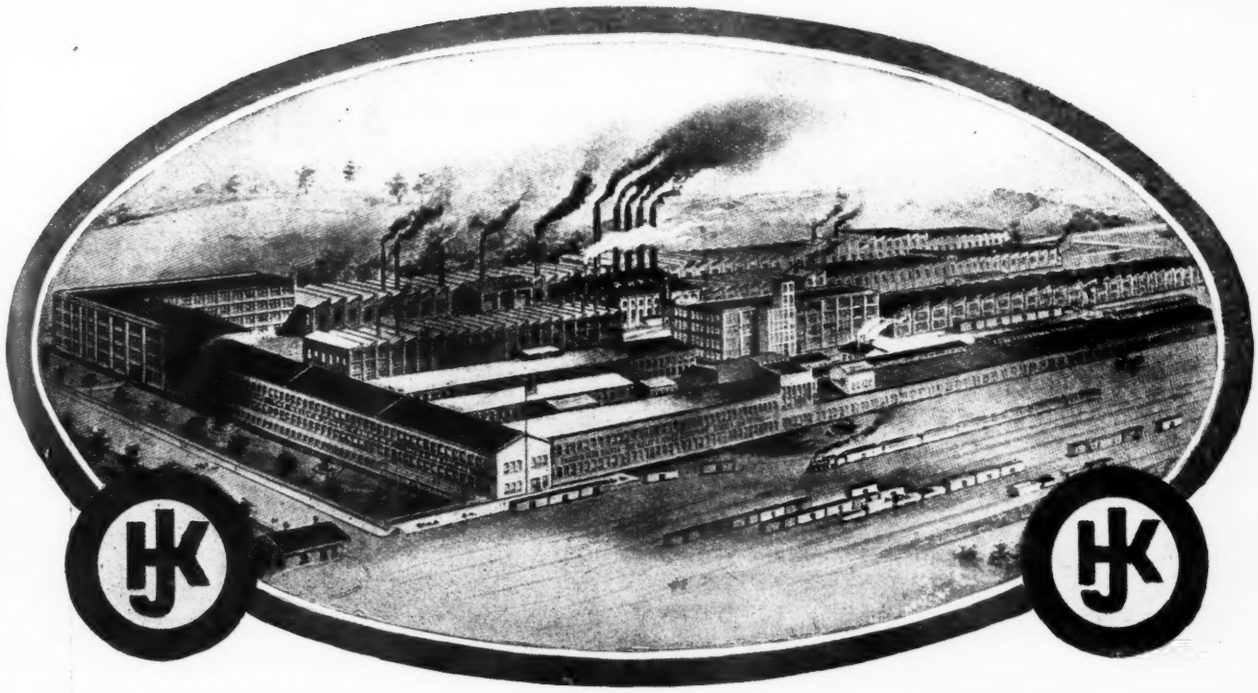

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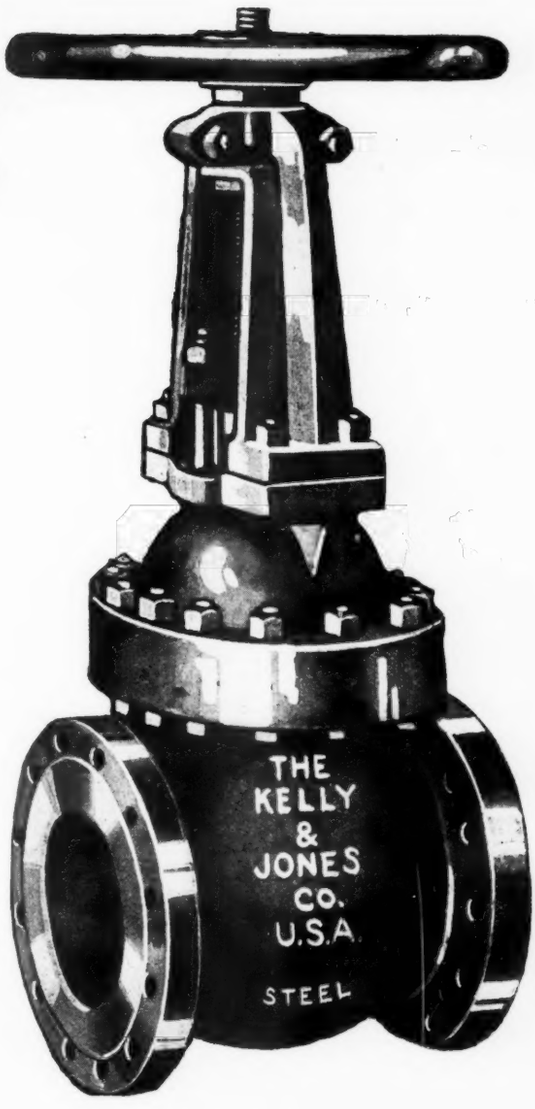

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"Can't Leak—Won't Stick"

THEY are scientifically designed to maintain a perfect balance, also to provide ample lubrication for the plug—thus protecting it against corrosion and allowing it to turn freely.

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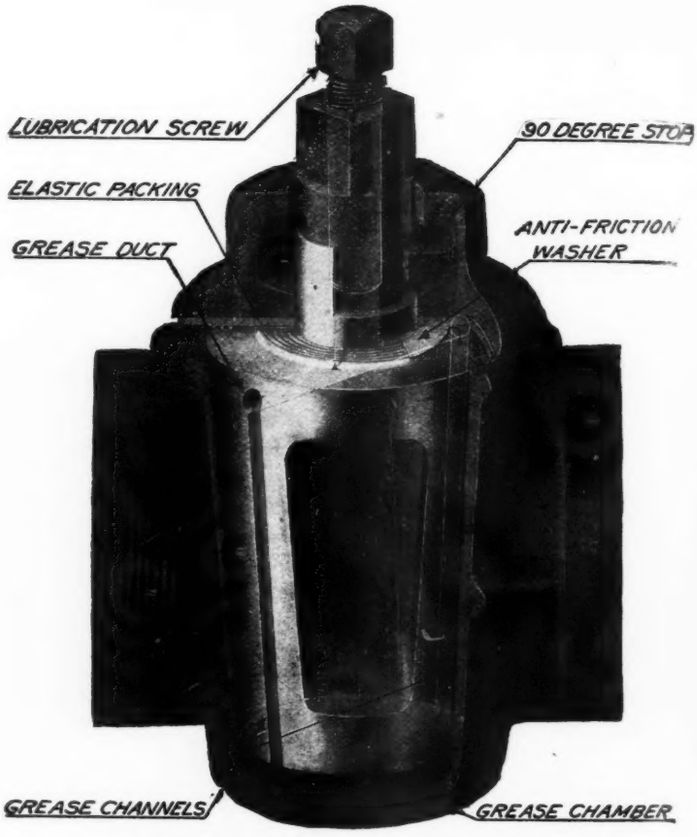

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Just take, for instance, their durability—they have, in a number of cases, outlived the boilers on which they were installed and, in fact, one that we actually know of, went for 28 years before the first repair was necessary. Then it was only a matter of grinding out the worn part.

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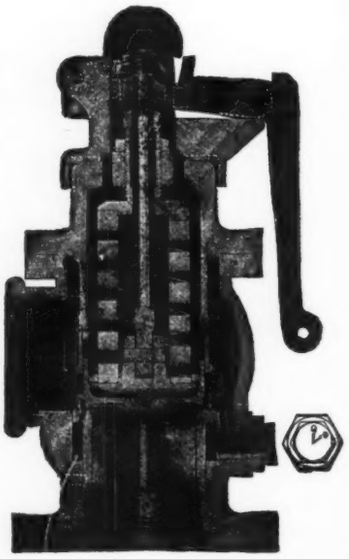

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Regulating Valves, Balanced Valves, Back Pressure Valves, Float Valves, Exhaust Relief Valves, Non-return Valves, Stop and Check Valves, Steam Traps, Pump Governors, Flow Regulators, and other Steam Savers. *Write for Complete Catalog.*

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To Eliminate Slip

Equip your pumps with the permanently tight seating

WORDEN Turbo-Pump Valves

They turn slightly with every seating. Do not wear ridges. Four times the life of ordinary valves.

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Cadman Indestructible Blow-Off Valve—1914 Pattern

Pronounced "the strongest valve made." Monel metal reversible seat and disc, extra heavy construction throughout. The Standard Blow-Off Valve for big boilers. Ask for the catalog.

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A combined safety device, non-return valve, positive stop valve, alarm and steam separator. Protects Lives and Property.

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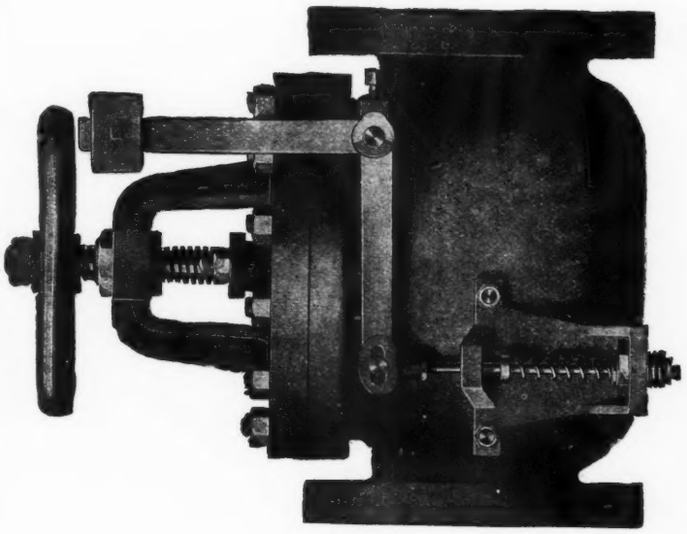
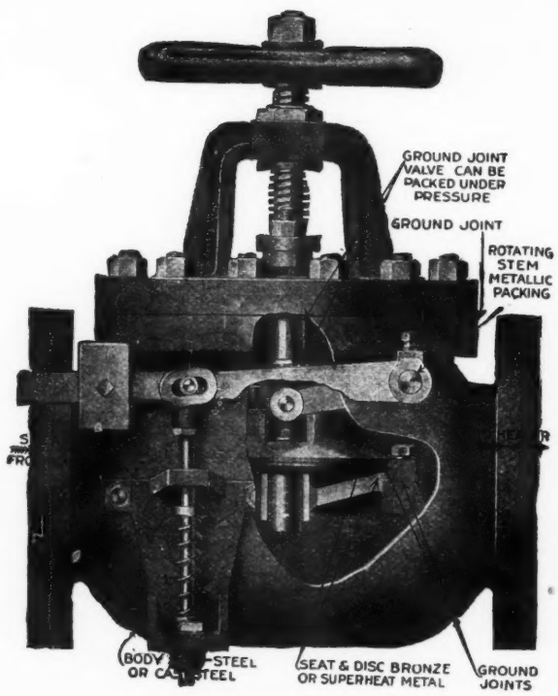
CLEVELAND, OHIO Published in the Interest of Power Plant Economy JUNE 22, 1920

Shutdowns Are Unnecessary




GROUND JOINT VALVE CAN BE PACKED UNDER PRESSURE
GROUND JOINT
ROTATING STEM METALLIC PACKING
SEAT & DISC BRONZE OR SUPERHEAT METAL
GROUND JOINTS

DON'T shut down your plant, because of a tube rupture or other break in any one boiler.

It is unnecessary, if you'll equip all boiler connections with

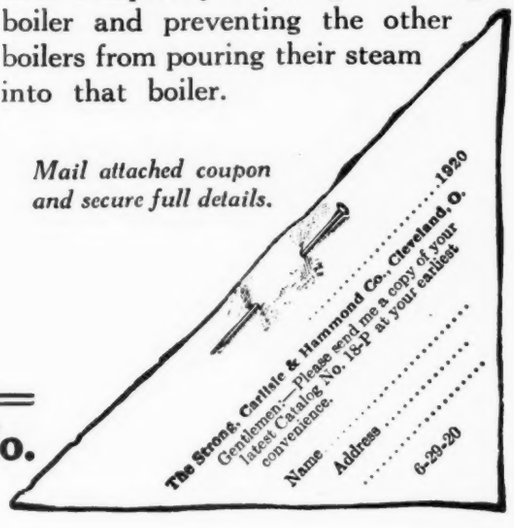
The *New* STRONG Non-Return Stop Valves

and stop the remaining boilers from pouring out their steam into the damaged one.

The position of the outside lever shows whether the valve is open or closed. The lagging boiler is thus pointed out to the men, and is of great assistance to them in equalizing the load between all boilers.

Automatic closure of the valve follows the instant that the tube lets go, thus completely isolating a damaged boiler and preventing the other boilers from pouring their steam into that boiler.

Mail attached coupon and secure full details.


The Strong, Carlisle & Hammond Co., Cleveland, O.
Gentlemen:—Please send me a copy of your latest Catalog No. 18-P at your earliest convenience.
Name .....
Address .....
6-29-20
1920

The Strong, Carlisle & Hammond Co.
Cleveland, Ohio

Swartwout

Hydromatic TRADE MARK

STEAM TRAPS

Patented

At 100 lb. pressure, enough steam escapes, through an aperture of 1-10 of a square inch in a ten-hour day to equal 845 lbs. of coal, (Napier's formula). At $3.00 a ton this loss totals $30.18 per month.

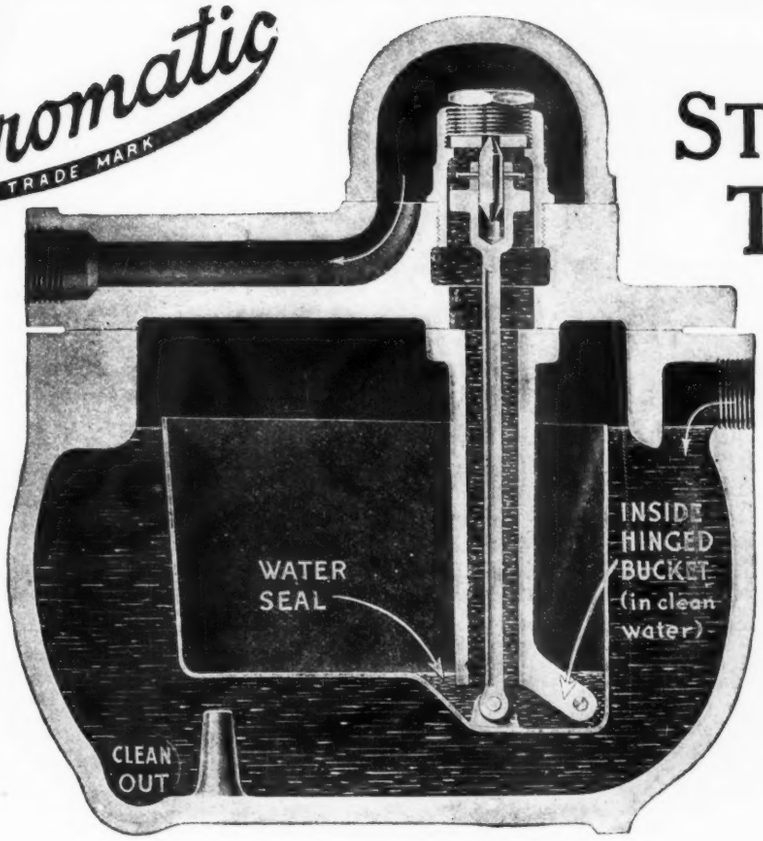
SWARTWOUT Hydromatic Steam Traps save coal in three ways: *first,* by preventing any waste of steam from your coils or heaters; *second,* by increasing the efficiency of coils and heaters by keeping them free of water and constantly working at full capacity; *third,* by performing more effectively and dependably than other devices intended for the same purpose.

Intermittent in action, the opening of the trap allows the full force of the steam to drive through the pipes blowing out all water which has collected on the sides and in the pockets, leaving them free to radiate at full capacity. When the steam reaches the trap the valve is instantly closed and water-sealed,—no steam can escape. The action is positive and simple as there are no delicate temperature adjustments or small, delicate parts to get out of order.

Ruggedly built, with few parts and fool-proof, SWARTWOUT Hydromatic Steam Traps appeal strongly to the economical plant owner. In many instances they have paid for themselves in less than one month.

Swartwout

Hydromatic TRADE MARK STEAM TRAPS



REG. U.S. PAT. OFF. Swartwout The OHIO Body and Blower Co. Cleveland, U.S.A.

Note these ten big features

1 Operates on gravity and buoyancy only.

2 Has only two moving parts.

3 Bucket operates in clean water on self-cleaning hinge.

4 Patented water-sealed valves.

5 No float to collapse.

6 Monel metal valve and seat.

7 Discharges water only—no steam.

8 No wire drawing of steam to cut the valve.

9 Adaptable to any pressure up to 250 lb. by change of valve.

10 Guaranteed for ABSOLUTE satisfaction.

There's a bulletin on this trap which should be read by every plant owner or operator—write for it.

SWARTWOUT SPECIALTY DIVISION
of
THE OHIO BODY & BLOWER CO., CLEVELAND, O.

THE NEW BUNDY Hot Water Tilting Pumps handle a *larger* volume of water. They handle as much as *seven times* the volume handled by ordinary traps of equal pipe size connections. They have a fixed discharge valve which will not leak steam, water or air, and is actuated by the movement of the bowl.

Adjustment of return pressure at the inlet is never required.

No condensate can be carried by, regardless of fluctuations in the inlet pressure between a vacuum and 100 lbs.

Mfrs. of Bundy Return Traps—Bundy Separating Traps—Bundy Vacuum Traps and Bundy Tilting Traps.

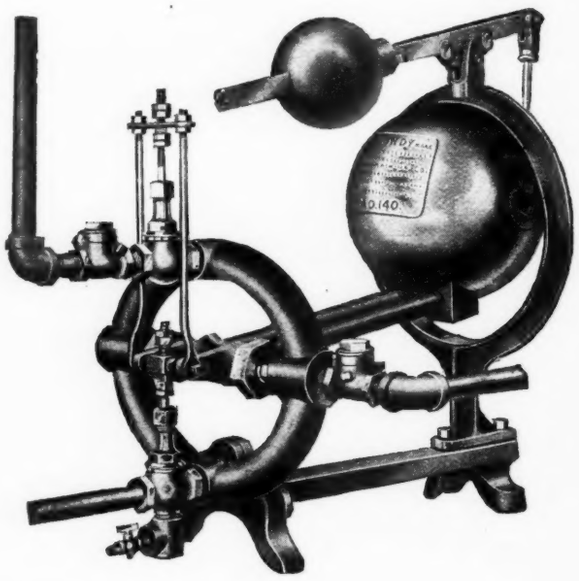
Nashua Machine Company
Nashua, N. H.

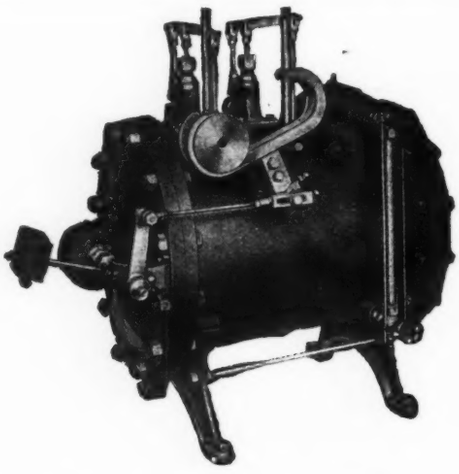
BRANCH OFFICES:

Boston	New York	Philadelphia	Baltimore
127 Federal St.	74 Cortlandt St.	Pennsylvania Bldg.	Equitable Bldg.

BUNDY Service will help you to put a Bundy Pump or Bundy Trap where it will do the most effective work.

Write or phone our nearest office for Catalog "G" and any information.





Sterling Steam Traps

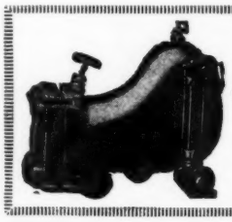
save coal and reduce boiler stresses, by returning the condensate under pressure at a temperature of 300 deg. F. or more right into the boilers.
Once installed you can practically forget them. They need no coaxing or adjusting to keep them in service. Get all the facts. *Write.*

Templeton Mfg. Company
115 Business St., Hyde Park, Mass.

Water
Rectification Systems
of every description

Pressure and Gravity Softeners - Iron and Oil Removal Apparatus - Pressure and Gravity Filters - Filtration Equipment

The Permutit Company
440 Fourth Ave. New York

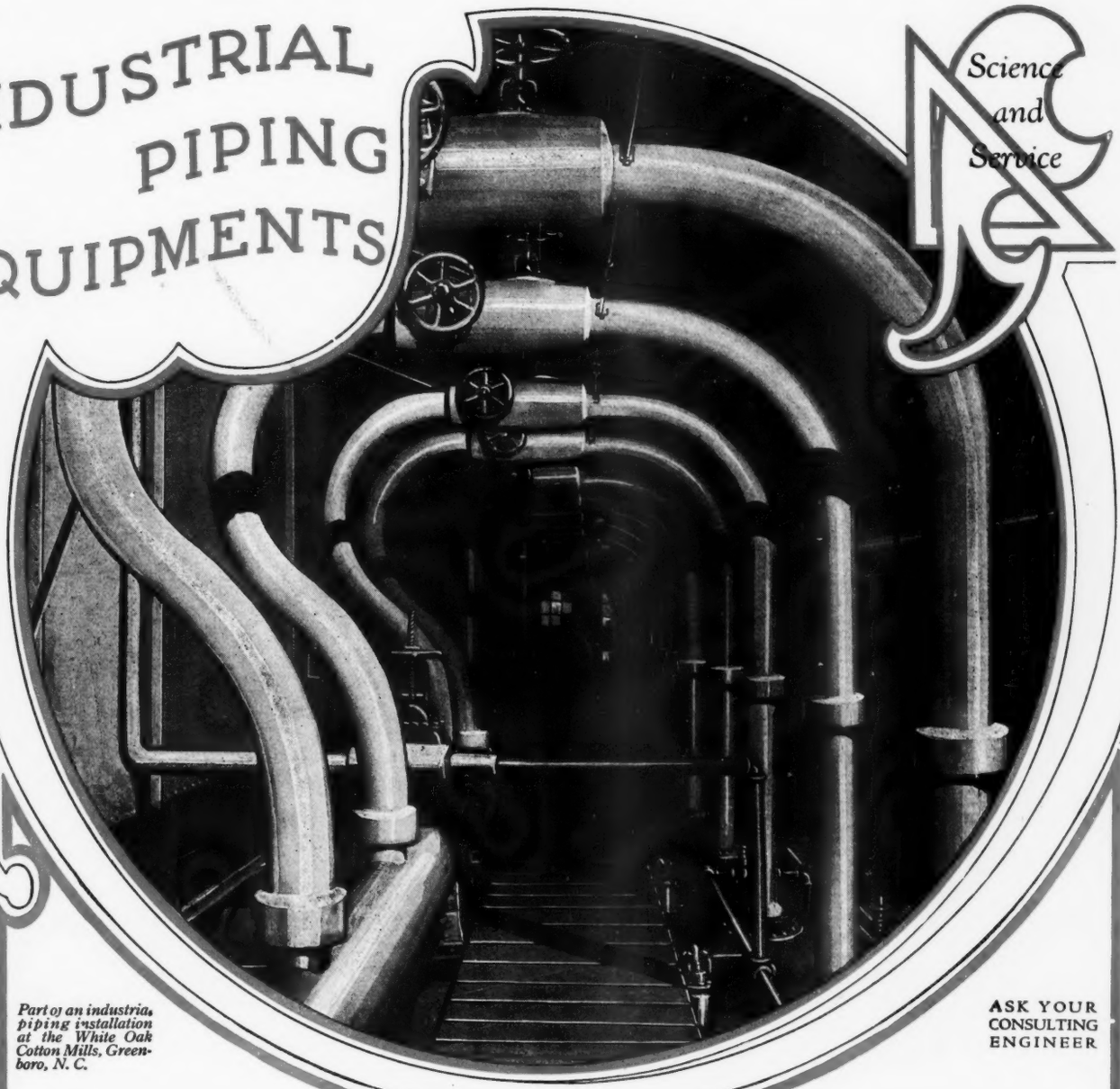


McDaniel Improved Traps
mean
CONTINUOUS OPERATION
without Steam Leakage
Write for information
Watson & McDaniel Co.
150 N. 7th St., Philadelphia, Pa.

ALBANY STEAM TRAP CO.
ALBANY, N. Y.
Manufacturers of
RETURN STEAM TRAPS
NON-RETURN STEAM TRAPS
PUMP GOVERNORS, ETC.

INDUSTRIAL PIPING EQUIPMENTS

Science and Service



Part of an industrial piping installation at the White Oak Cotton Mills, Greensboro, N. C.

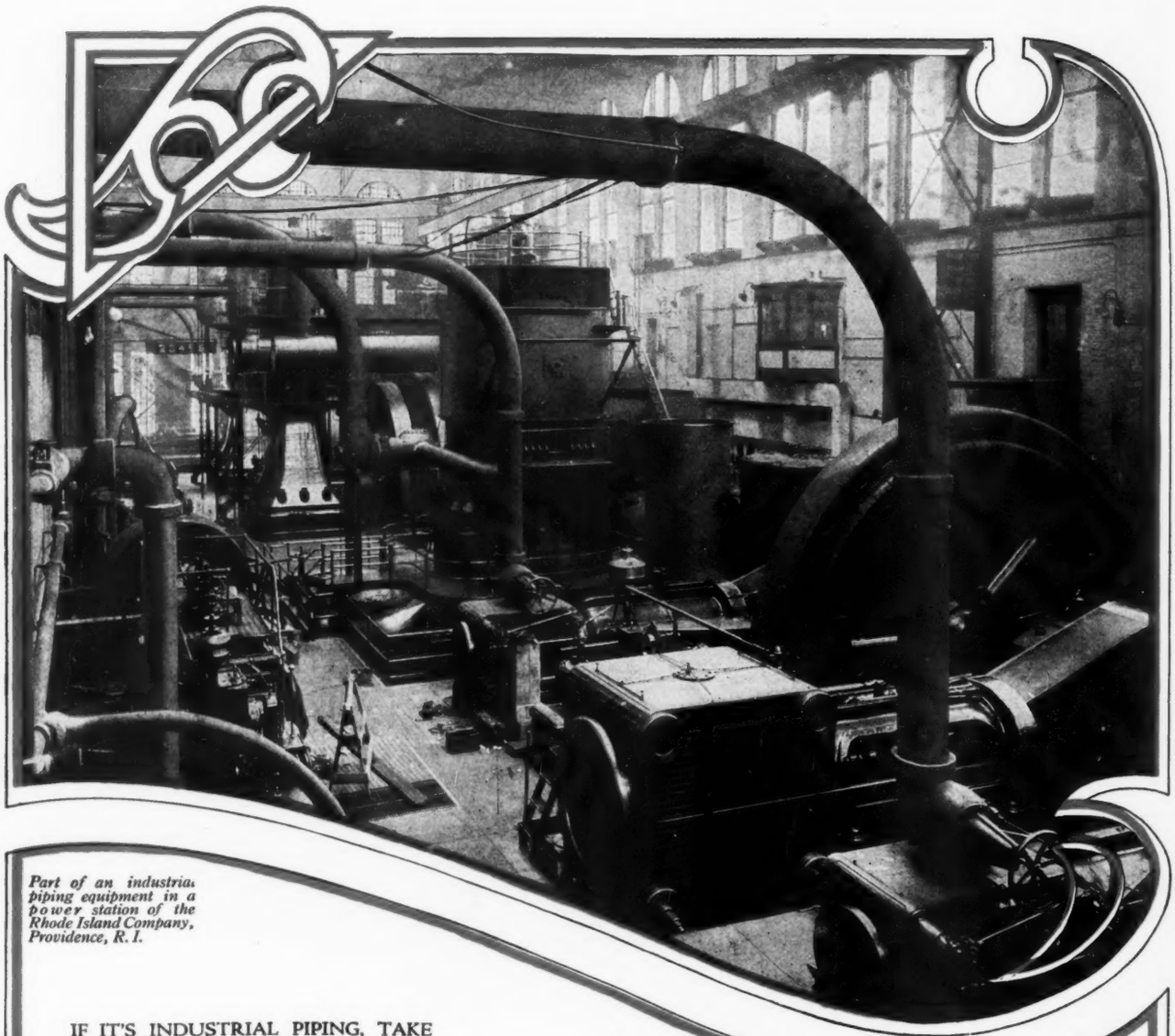
ASK YOUR CONSULTING ENGINEER

Besides Engineering

Engineering experience is vital in an industrial piping installation like this. But beyond engineering is installation,—the practical putting into operation of engineering plans. In both respects the Grinnell Organization is complete, having offices in all large cities in the United States and Canada.

GRINNELL COMPANY

EXECUTIVE OFFICES PROVIDENCE, R. I.



Part of an industrial piping equipment in a power station of the Rhode Island Company, Providence, R. I.

IF IT'S INDUSTRIAL PIPING, TAKE IT UP WITH GRINNELL COMPANY

Automatic Sprinkler Systems
Steam, Hot Water and Gas Heating
Power and Related Piping
Pipe Bending, Threading and Fabricating
Welding
Fittings, Pipe, Valves
Process Piping of all kinds
Piping for Acids and Alkalies
Compressed Air Lines
Water Supply Systems
Hydraulic Piping
Gordon Dryers
Safety Fuel Saver
Constant Level Size Circulating System

GRINNELL COMPANY through 70 years of experience has gained a fund of practical knowledge of industrial piping that is a distinct asset to those seeking an unusual service in industrial piping work.

In some instances our being the largest organization in the field may prove a further asset where *quick* manufacture or parts and speedy construction are vital requirements.

GRINNELL COMPANY

INCORPORATED

EXECUTIVE OFFICES PROVIDENCE, R. I.

OFFICES IN ALL LARGE CITIES OF THE UNITED STATES AND CANADA

Can You Save ⅔ Your Steam Trap Costs by Installing the Steam Trap Sarco?

That depends upon what your requirements are.

We do not claim that the Sarco replaces every steam trap on the market. But we do say that in its OWN FIELD, the position of Steam Trap Sarco is unassailable.

The Sarco is the only liquid expansion trap made. Therefore, if your pressure is between 15 and 200 pounds, your choice is limited to the Sarco or a cumbersome bucket or float trap costing three to four times as much.

Price, however, is not the only advantage that Sarco holds over the bucket or float trap. Sarco is small, easily installed and highly flexible. It measures only a few inches, screws right onto the pipe like an elbow and requires no building up or special foundation.

In every big plant there are many points which should be trapped, but where there is no room for a large trap, and the cost of ordinary traps would be prohibitive. In such places you can install a Sarco and save all around.

If you are not sure whether the Steam Trap Sarco will meet your requirements, tell us what they are and we will advise you candidly. If another type is better for you, we will not attempt to sell you ours.

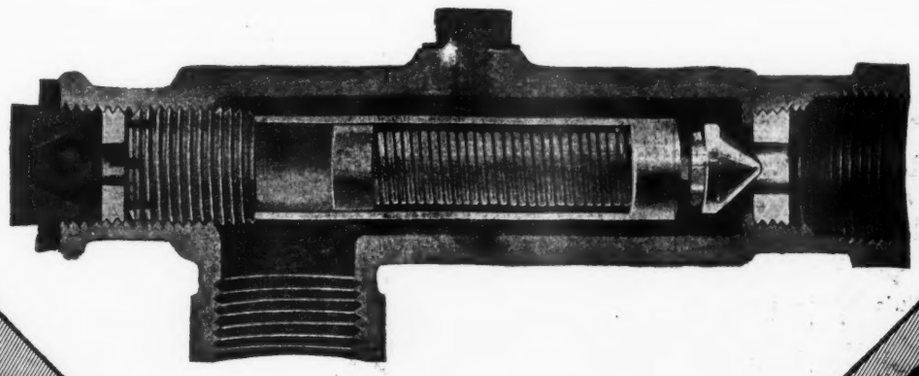
Where there is any doubt in your mind or in ours we will send you Steam Traps for a FREE TRIAL, so that you can be SURE that Sarco is the trap for you before you incur a single cent of expense.

Send for our new price list, Booklet A-5, and free card model, which shows how Sarco operates.

SARCO CO., INC.

229 Broadway, New York City

Ellicott Square ..... Buffalo	Majestic Building ..... Detroit
Monadnock Block ..... Chicago	Drexel Building ..... Philadelphia
6523 Euclid Avenue ..... Cleveland	Peacock Bros. ..... Montreal



Measure Your Feed Water

with a HOPPES V-NOTCH METER, and determine whether or not your plant is being operated economically, and the maximum amount of power is being generated.

There is a constantly increasing demand for Hoppes V-Notch Meters, as leading engineers after careful investigation have found the HOPPES to be the most accurate meter in the world. Hoppes Meters are in daily use in some of the largest plants in the country.

Another feature in favor of the Hoppes Meters is the extreme simplicity of construction. There are no complicated parts to get out of order.

There are other advantages in the Hoppes V-Notch Meters which are not found in any other, and if you are interested in metering your feed water it will pay you to investigate the merits of the Hoppes Meter. We have a new catalog which fully describes and illustrates our Meters, and we will send you a copy of same on request.

We also manufacture FEED WATER HEATERS, LIVE STEAM FEED WATER PURIFIERS, STEAM AND OIL SEPARATORS AND EXHAUST HEADS.

THE HOPPES MFG. CO.

19 LARCH STREET, SPRINGFIELD, OHIO

Regardless of sudden heavy drafts, or fluctuations in the supply of exhaust steam —a constant supply of hot water is always assured by

WHITLOCK Type K Storage Heaters
Horizontal or Vertical

"WHITLOCK HEATERS
Have Everlasting Copper Tubes"

Write for Bulletin No. 40

WHITLOCK COIL PIPE CO.
Hartford, Conn.
Branches in Principal Cities

Morehead Back to Boiler SYSTEM

Feed Your *Boilers* Pure Water HOT!

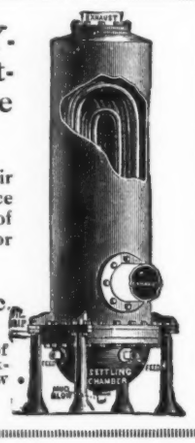
HOW much of your fuel are you wasting each month? To save all of the costly heat units it generates you must get the condensation back to the boilers while it is HOT.

The "*Morehead*" book will tell you *how*.

Ask for your copy AT ONCE.

Morehead Mfg. Co., Dept. E. 309 **Detroit, Mich.**

PATTERSON-BERRYMAN Feed Water Heaters and Purifiers are expense savers.



They take up little space—save their cost in coal, and repair saving—reduce scale troubles and increase efficiency of the boilers. 60 days' trial. Write for catalog.

The Patterson-Kelley Co., Inc.
28 Cortlandt St., New York

Also Manufacturers of Hot Water Heaters of all types, for all purposes, for use with exhaust or live steam, or in connection with low pressure heating systems.

ELESCO SUPERHEATERS and SUPER COILS
FOR ALL INDUSTRIAL PURPOSES

Send for Bulletins AT-1, AT-2 and AT-3

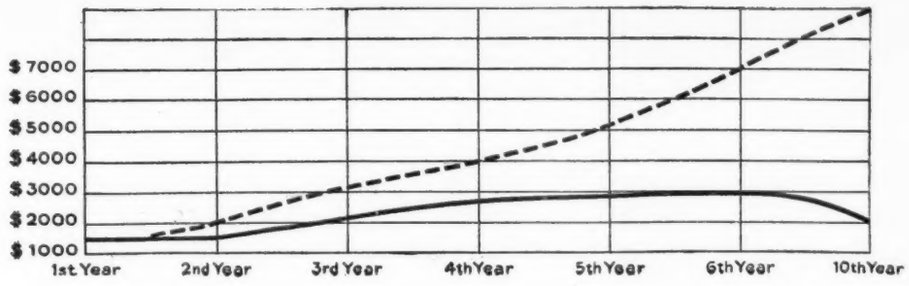
LOCOMOTIVE SUPERHEATER CO.
General Offices—30 Church St., New York
Pittsburgh—Oliver Bldg. Chicago—Peoples Gas Bldg.

USE J. R. S. FUEL BURNERS

These will keep the plant running

All Grades of Fuel Consumed Including Screenings, Coke Breeze, Etc.

Mechanicville Specialty Supply Mfg. Company
Mechanicville, N. Y.



Which Is Your Efficiency Line?

The full line in the chart above shows the usual progress of the average man who takes up work in the power plant. From helper, water tender or fireman up to engineer—but there he usually stops. Study the full line carefully.

Now what does the dash line show? Same start as helper, water tender or fireman up to engineer—but instead of following a horizontal line for many years it starts moving up into the $4,000 to $7,000 class very quickly.

What Has Happened?

The full-line man has been content to work along following the bitter route of experience and trusting to luck to make such progress as he could.

The dash-line man, however, saw a real opportunity from a fuel conservation standpoint. He realized that the largest item of expense at the plant was *fuel*, and right there lay wide open the avenue for success. He used his spare time to get information on fuel conservation—combustion—and has become a Combustion Expert. His services are in demand at a large salary at any time. How to get the training in Combustion Engineering without leaving one's work has, however, up to this time been quite a problem for the average man.

Learn Combustion the New Way

Conditions have changed considerably in the last few years. Economy in handling fuel is more necessary today than it ever has been. There are unlimited opportunities at the present time for the man who will learn good boiler room practice and obtain a better knowledge of combustion.

For the first time you have the opportunity of obtaining a thorough knowledge of combustion thru a non-resident Course, written in simple, everyday language—easy to understand—and completely illustrated in an interesting as well as an instructive way.

The Educational Staff

The leading authorities on Combustion have prepared and are directing this easy reading Course. Joseph W. Hays, Author and Educational Director, is widely known as one of the leading contributors to the literature of the subject. The educational staff of reviewing and advisory editors includes the best known men in the combustion field, all specialists and authorities on Combustion Engineering and Plant Management.

They are Arthur L. Rice, Editor of Power Plant Engineering; David Moffat Myers, Advisory Engineer for the U. S. Fuel Administration; W. L. Abbott, Chief Operating Engineer of the Commonwealth Edison Co. of Chicago; Fred R. Low, Editor of Power; Prof. S. W. Parr, Department of Chemistry, University of Illinois; Joseph Harrington, formerly Administrative Engineer, U. S. Fuel Administration, and I. E. Moultrop, Construction Bureau, Edison Electric Illuminating Company.

Spare Time Only Necessary

No technical education is needed to understand the Hays Course and Service. It requires only an average of one-half hour daily of your spare time to complete it on the regular schedule. The enrollment fee is very reasonable and easy terms of payment are allowed, if necessary.

The Course has been highly endorsed by leading engineering firms thruout the country, who have recommended the Course to their employees, and in a number of plants as many as fifteen to twenty men are enrolled.

Send for Free Book—"Opportunities for the Combustion Expert"

For the man who wants to forge ahead in the combustion field—who wants to change from a full-line to a dash-line man—we have prepared a handsome and interesting book, "Opportunities for the Combustion Expert." A copy will be sent free upon request.

It points out how in a very short time you can master the Hays Course and become a Combustion Expert with a considerably larger salary. Return coupon below today. Hays School of Combustion, Dept. 16B, 1412-14 S. Michigan Avenue, Chicago, Ill.

Send for Free Book—"Opportunities for the Combustion Expert."

Name .....

Address .....

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Hays School of Combustion
Dept. 16B, 1412-14 S. Michigan Ave.
Chicago, Illinois

Common Sense In Power Plant Operation Is the Keynote of

Fernald and Orroks'

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586 pages, 6 x 9, 309 illustrations
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On every page of this book is an idea, a suggestion or a plan that will help you to operate your power plant to the best advantage. It emphasizes the practical side of the subject. Common-sense is the keynote of the information this standard book offers.

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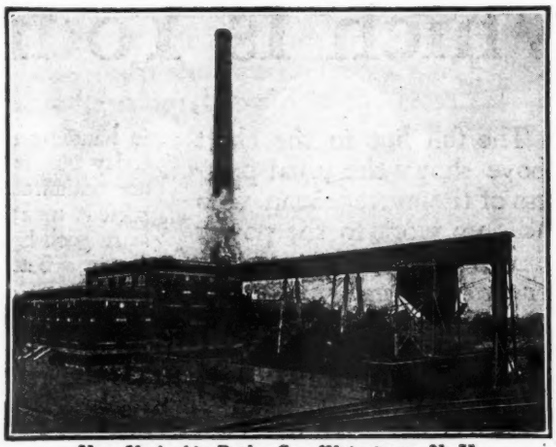
C. L. INSLEE EDWARD BURNS
W. G. HUDSON W. W. RICKER



New York Air Brake Co., Watertown, N. Y.

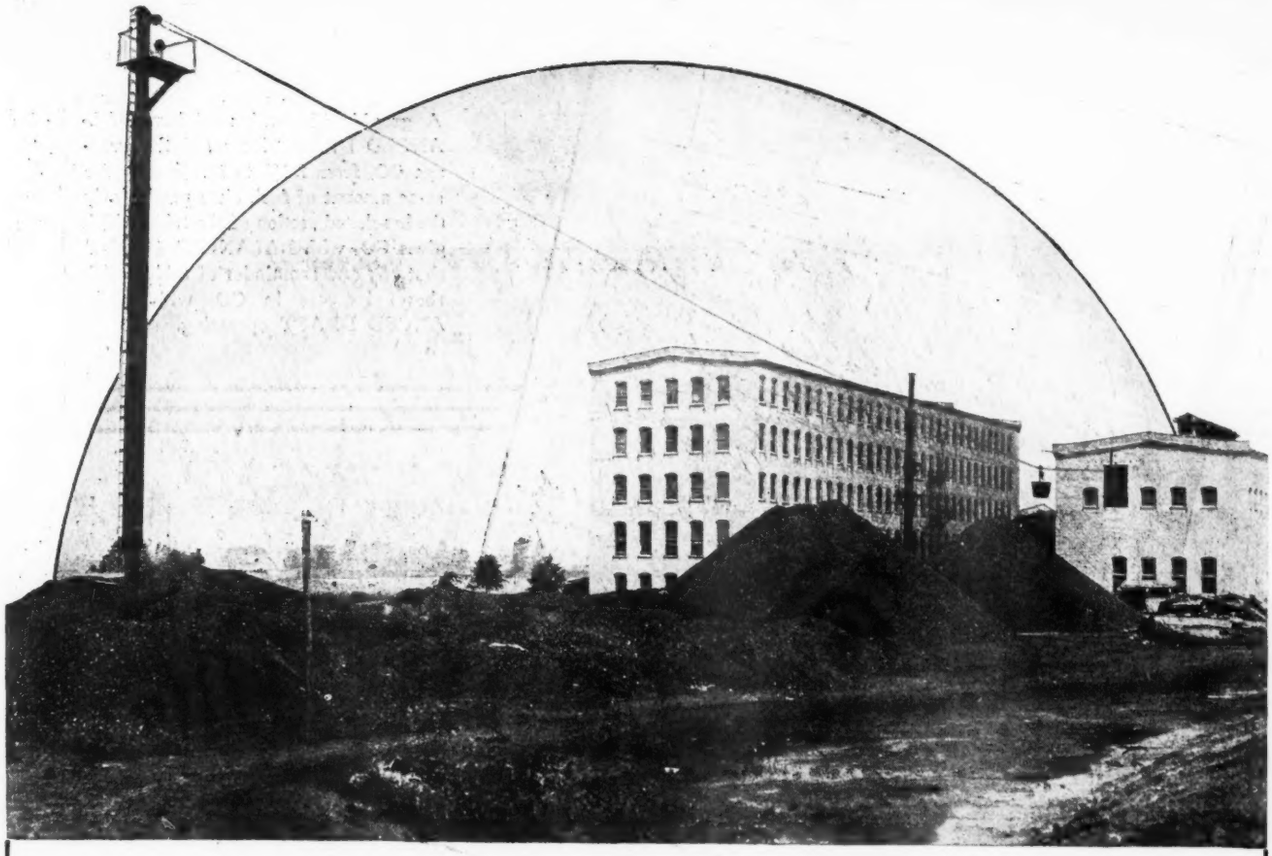
The Time Element

To minimize the period during which capital is idle—the period between decision-to-build and readiness-for-occupancy—tests the skill and resource of any contractor. We have the organization, the equipment, the purchasing power, the experience, which enable us to reduce the time element in building to the economic limit—without any sacrifice of quality in materials or construction, and without any increase in cost beyond that inevitably identified with speed work.

Bulletin 125—"Mills, Factories, Power Plants, and General Engineering Construction."

Address—138 Cedar St. New York

CONTRACTING ENGINEERS



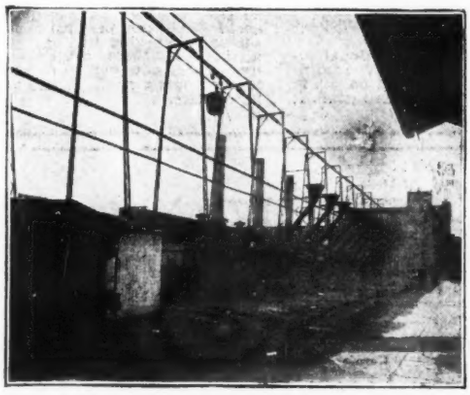
Typical Cable Way installation showing bucket traveling on cable and carrying coal into power house.

The Godfrey System will add to your profits

Your desire to save money in your handling of coal will lead to one conclusion; that the GODFREY SYSTEM IS INDISPENSABLE.

Years of engineering skill based on an intimate knowledge of coal handling problems has produced a system of coal conveying which is transforming liabilities into assets and *eliminating*

labor troubles, demurrage costs and waste of time.



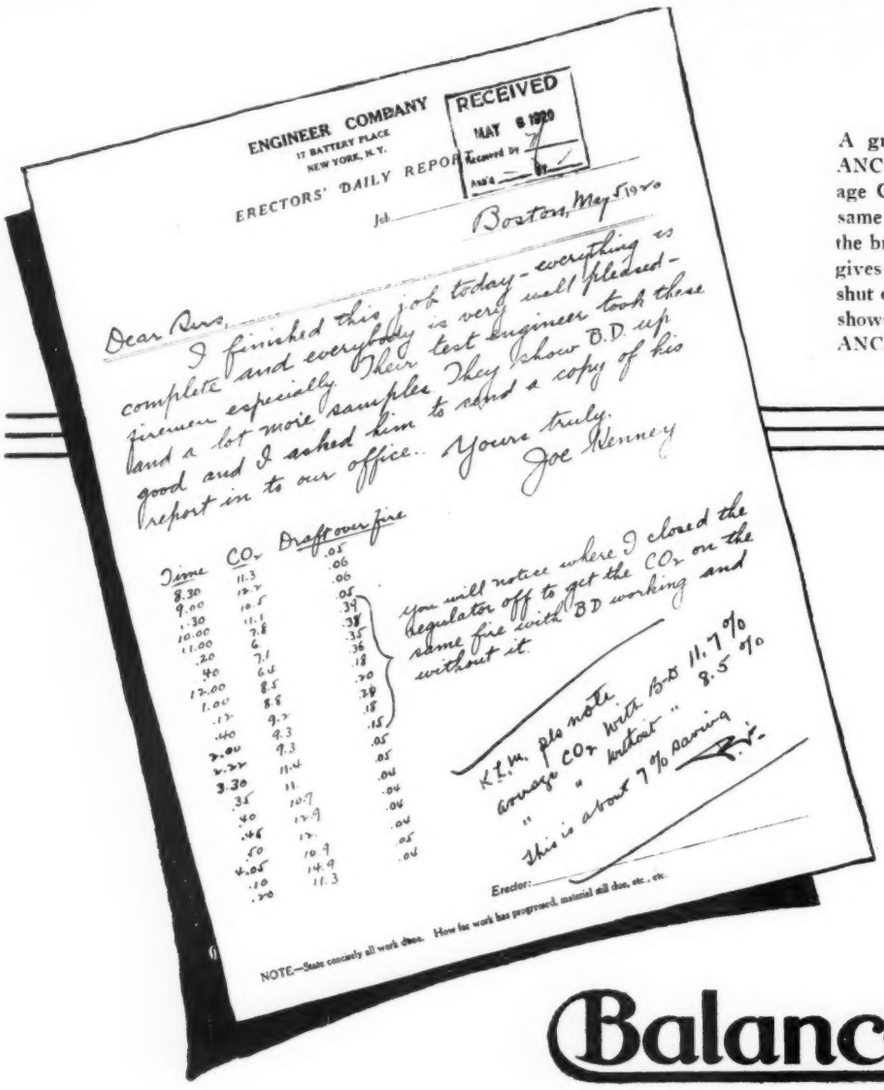
Popular Godfrey installation showing steel A-Frame type of construction and one ton bucket traveling on track.

We can serve you. The Godfrey System is specially adapted for every conveying requirement. It will unload your coal, coke, sand, gravel or similar material and place them wherever you desire. By means of a grab hook lumber and logs can be unloaded and piled quickly and economically.

One man operates the entire system by means of a motor driven hoist. The operator, hoist and motor are on the ground, which permits of economy of installation and operation.

Write for literature.

The Godfrey Conveyor Company
113 13th St., Elkhart, Indiana



ENGINEER COMPANY
17 BATTERY PLACE
NEW YORK, N.Y.

RECEIVED
MAY 6 1920

ERECTORS' DAILY REPORT

Jd. Boston, May 5 1920

Dear Bus,

I finished this job today - everything is complete and everybody is very well pleased - firemen especially. Their test engineer took these and a lot more samples. They show B.D. up good and I asked him to send a copy of his report in to our office. Yours truly.

Joe Kenney

Time	CO_2	Draft over fire
8.30	11.3	.05
9.00	12.7	.06
.30	10.5	.05
10.00	11.1	.34
11.00	6	.32
.20	7.8	.35
.40	7.1	.36
12.00	6.6	.18
1.00	8.5	.30
.12	8.8	.38
.40	9.7	.18
2.00	9.3	.15
2.22	9.3	.05
3.30	11.6	.05
.35	11.	.04
.40	10.7	.04
.45	12.9	.04
.50	12.	.04
4.05	10.9	.05
.10	14.9	.04
.20	11.3	

you will notice where I closed the regulator off to get the CO_2 on the same fire with BD working and without it.

K.L.M. pls note average CO_2 with BD 11.7 %
" " without " 8.5 %
this is about 7% saving
R.I.

Erector:

NOTE—State concisely all work done. How far work has progressed, material still due, etc., etc.

A graphic illustration of how BALANCED DRAFT increased the average CO_2 from 8.5% to 11.7% with the same amount of fuel. Note particularly the bracketed section of the table which gives CO_2 with BALANCED DRAFT shut off; and remainder of table which shows increase in CO_2 with BALANCED DRAFT operating.

Balanced Draft

Can Increase Your CO_2

THE figures in the above letter show the astonishing results obtained by Balanced Draft in a large New England Plant.

With Balanced Draft operating the draft over the fire was maintained at .05 and .06. This gave maximum production of CO_2. Then Balanced Draft was shut off and the CO_2 fell from 11.1% to 7.8% and in 20 minutes, to 6%. Balanced Draft was again thrown in. Instantly and automatically the draft was returned to and maintained at the correct suction for perfect combustion. CO_2 jumped at once to 11.1%.

The case is not a single, exceptional instance, but one of many startling records made in over 2,000,000 H.P. of boilers in which Balanced Draft has been installed; and represents only a small part of the yearly saving in fuel accomplished by Balanced Draft—now over 750,000 tons annually.

"and everybody is very well pleased."

If a mechanical device would increase your CO_2 from an average of 7.8% to 11.1% wouldn't you be pleased? Balanced Draft can perform for your plant the same amazing fuel savings that it is getting for these other boilers. Two cents spent now may save you thousands in the coming year. Write us today for particulars.

The Engineer Company

17 Battery Place — **Turner Baffle Walls** — **New York City**

Produced exclusively by The Engineer Company

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CHICAGO
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CLEVELAND
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DETROIT
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MONTREAL
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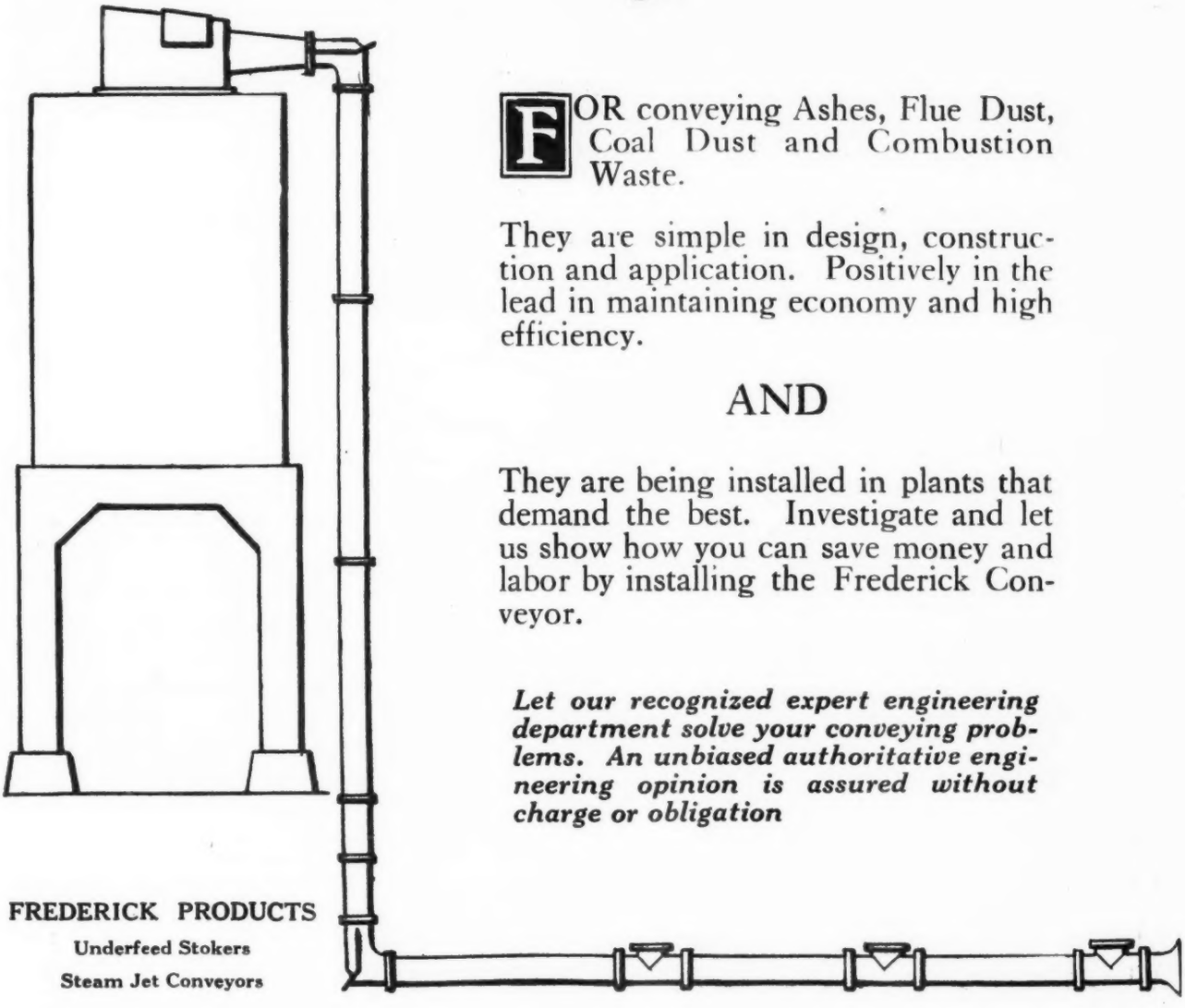
NEW ORLEANS
847 Baronne Street
PHILADELPHIA
1010 Harrison Building
PITTSBURGH
Jenkins Arcade Building
ST. LOUIS
Railway Exchange Bldg.
WILKES-BARRE, PA.
21 Bennett Building

Frederick *Steam Jet* Conveyors



FOR conveying Ashes, Flue Dust, Coal Dust and Combustion Waste.

They are simple in design, construction and application. Positively in the lead in maintaining economy and high efficiency.

AND

They are being installed in plants that demand the best. Investigate and let us show how you can save money and labor by installing the Frederick Conveyor.

Let our recognized expert engineering department solve your conveying problems. An unbiased authoritative engineering opinion is assured without charge or obligation

FREDERICK PRODUCTS

Underfeed Stokers

Steam Jet Conveyors

THE FREDERICK ENGINEERING CO.

FREDERICK, MARYLAND, U. S. A.

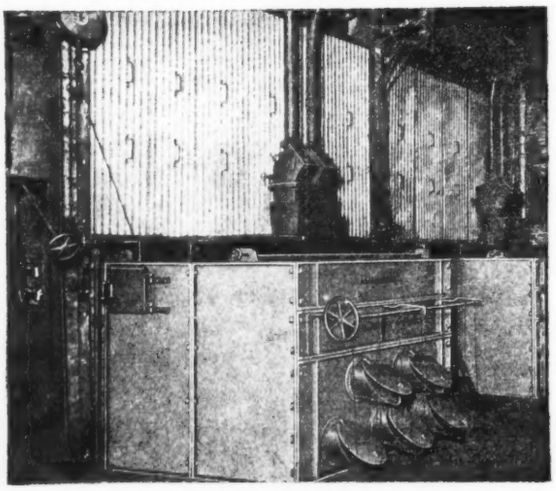
MAIN OFFICE:
61 BROADWAY, NEW YORK

Cleveland Office:
956 LEADER-NEWS BLDG.

Pittsburgh Office:
JENKINS ARCADE

Philadelphia Office:
1010 HARRISON BLDG.

Lopulco Systems



Induced Draft

To burn powdered coal efficiently in steam boilers, to avoid slagging and boiler setting troubles it must be burned at low velocity.

LOPULCO Pulverized Fuel Systems are the only systems embodying the induced draft principle.

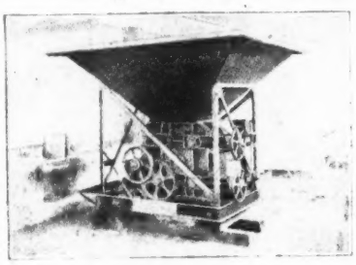
LOPULCO Systems are fully protected in their exclusive right to this method.

PULVERIZED FUEL EQUIPMENT CORPORATION

INTERNATIONAL PULVERIZED FUEL CORPORATION
30 CHURCH STREET
NEW YORK

Lopulco Systems

Orton & Steinbrenner Co.
Dependable Coal Crushers



Produce clean and uniform coal, graded for stoker use, and free from dust and "fines." Rolls can be separated to allow coal to pass between, without running the crusher. All wearing parts built of cast steel, insuring longest wear and lowest maintenance expense.

ORTON & STEINBRENNER CO.
Factory: Huntington, Indiana 608 S. Dearborn St., Chicago

Brady Power Plant Equipment

Traveling Grate Stokers — Steam Jet Ash Conveyors
Automatic Coal Scales — Flat Furnace Arches

Write for Catalog

THE JAS. A. BRADY FOUNDRY CO.
45th St. and Western Blvd., Chicago

SIMPLEX

STEAM JET CONVEYORS
For Handling ASHES, SOOT, COAL SIFTINGS, FURNACE DUST, LOCOMOTIVE CINDERS.
United Stokers Corp., Old Colony Bldg., Chicago, Ill.

THE SCOOP CONVEYOR

OVER 2000 USERS
FOR STORING AND RECLAIMING, LOADING AND UNLOADING CARS, TRUCKS AND WAGONS
DOES THE WORK OF FROM 6 TO 12 MEN
AND KEEPS EQUIPMENT MOVING
WRITE FOR LITERATURE
PORTABLE MACHINERY CO., PASSAIC N.J.

Webster Equipment

Elevating, Conveying and Coal Rehandling Machinery

Put your problems up to the engineers of a company which has ranked high for over forty years.

The Webster M'f'g Company
Factories in Chicago and in Tiffin, Ohio
Executive Offices: 1500 Cortland St., Chicago
Sales Offices in Principal Cities

Girtanner
Standardized Steam Ash Conveyor

Removes ashes from boiler to ash pit mechanically. Saves labor, saves money

GIRTANNER ENGINEERING CORP.
1100 Broadway, New York

PULVERIZED COAL EQUIPMENT

FIRE YOUR BOILERS WITH PULVERIZED COAL

Fuller-Lehigh Equipment prepares over 25,000 tons of pulverized Coal every day for Industrial and Power Purposes. Ask for Catalogue No. 71.

Main Office: Fullerton, Pa., U. S. A.

New York, N. Y., 50 Church St.; Chicago, Ill., 1336 McCormick Bldg.; San Francisco, Cal., 719 Sheldon Bldg.; Seattle, Wash., 714 L. C. Smith Bldg.; 25 Victoria St., Westminster, London, S.W.L., England. Hamburg 1, "Wallhof," Glockingiesserwall 2, Germany.

"A SYSTEM OF SAVING"

For Reduced Steam Cost

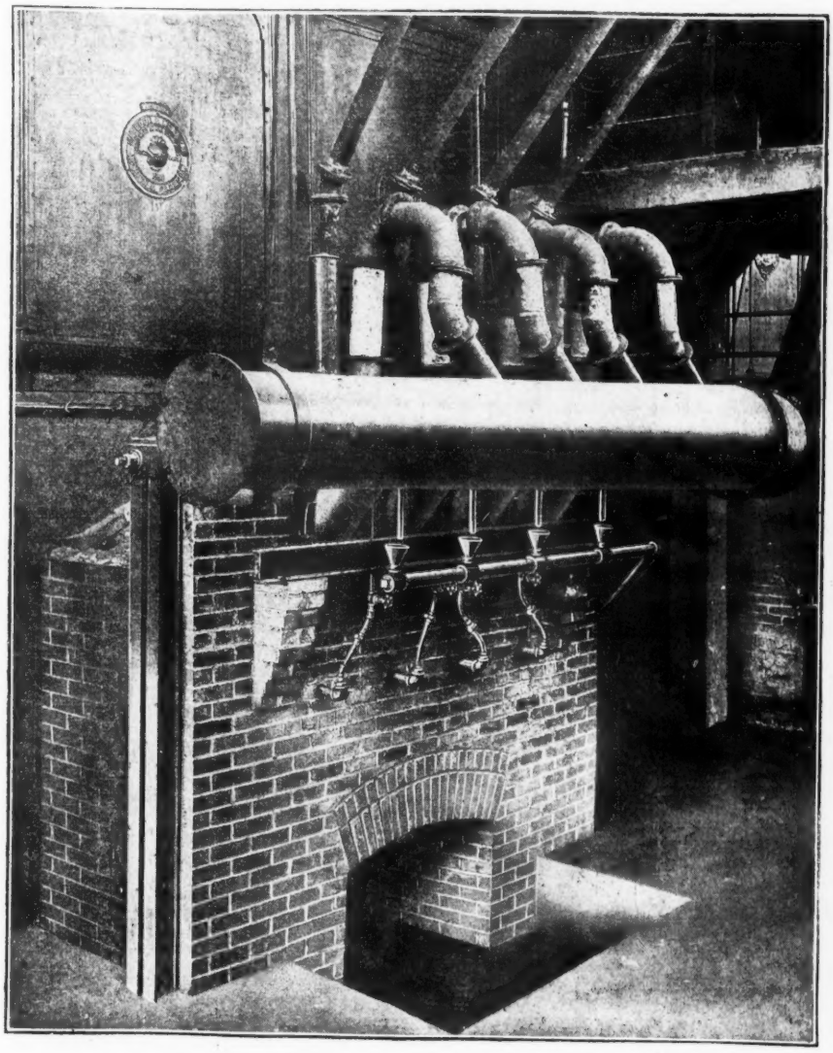
A much higher boiler furnace efficiency can be steadily maintained by burning pulverized coal and a better evaporation is assured with a Holbeck Pulverized Coal System.

Unexcelled in operating economy by the best stoker installations.

Positively reliable, with a high degree of flexibility to meet changing load demands.

Saves labor in firing and handling. Simplifies distribution. Greatly reduces standby losses. Gives the operator perfect control of fire.

The pulverized coal reaches the boiler furnace in a finely divided state and thoroughly dry. Smokeless combustion is easily maintained under all conditions.



Ask our engineers to estimate the savings that could be made in your plant. No obligation for this service.

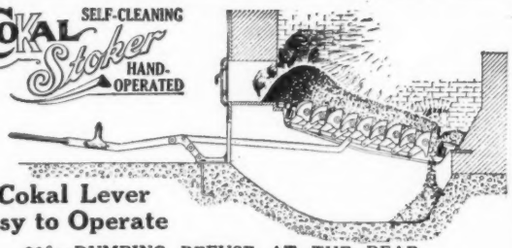
The Bonnot Company
POWER PLANT DEPT.
Canton, Ohio

258 Frick Annex, Pittsburgh, Pa.
Continental and Commercial Bank Bldg., Chicago, Ill.
1402 Morris Blvd., Philadelphia

HOLBECK
PULVERIZED COAL SYSTEMS
(FOR PLANTS OF MORE THAN 500 HP.)

THE SIMPLEST STOKER IN THE WORLD

The COKAL Stoker SELF-CLEANING HAND-OPERATED

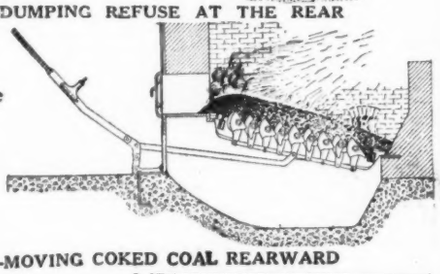


The Cokal Lever Is Easy to Operate

90°—DUMPING REFUSE AT THE REAR

Leveling the Fuel Bed Before Adding More Coal

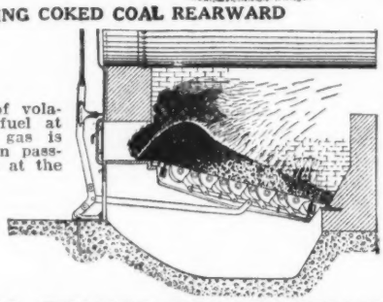
No Multiplicity of Levers



45°—MOVING COKED COAL REARWARD

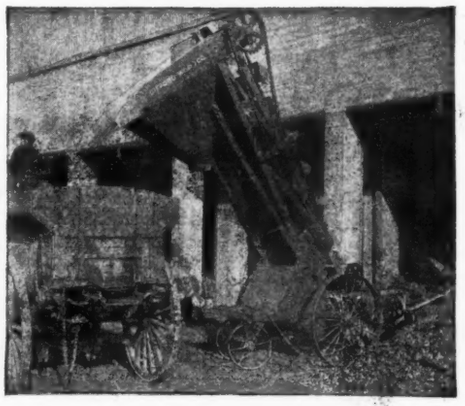
Immediately After Firing

Note the distillation of volatile gas from green fuel at furnace front. This gas is completely consumed in passing over the **hot coke** at the rear of furnace.



One Lever Does It All!!

COKAL CUTS COAL COSTS— **COKAL STOKER CORPORATION**
1027 N. Clark St., Chicago, Ill.



LET us show you, after a thorough study of your plant conditions, why it will pay you better to handle your coal mechanically, between your point of delivery and the boiler furnace.

Shall we send Bulletin 31?

Gifford-Wood Co.

Hudson, New York, U. S. A.

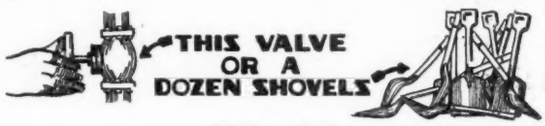
Boston Chicago Buffalo New York

THE ROACH STOKER

has greater capacity and dependability and is more efficient.

Write for the new bulletin

JOSEPH H. ROACH & CO., Inc.
221 So. 15th Street, Philadelphia, Pa.



Which?

Hammelizing your boiler plant accomplishes much more than the generation of power at a lower fuel cost.

Eighty per cent. of the direct labor in a boiler plant may be saved through the Hammel System, the capacity of boiler and stack greatly increased, instant flexibility always available.

Hammel Oil Burning Equipment Company
185 Devonshire St., Boston, Mass.

HammeL OIL BURNING SYSTEMS

110-10

The Original Hand Stoker

HUBER HAND STOKER

PATENTED

Sole Manufacturers

Flynn & Emrich Company
Established Over 70 Years

Baltimore Maryland

The Lehigh Stoker
FOR
Bituminous Slack—Fine Grades of Anthracite
Coke Breeze—

Water Cooled Grates. Simple. Efficient.

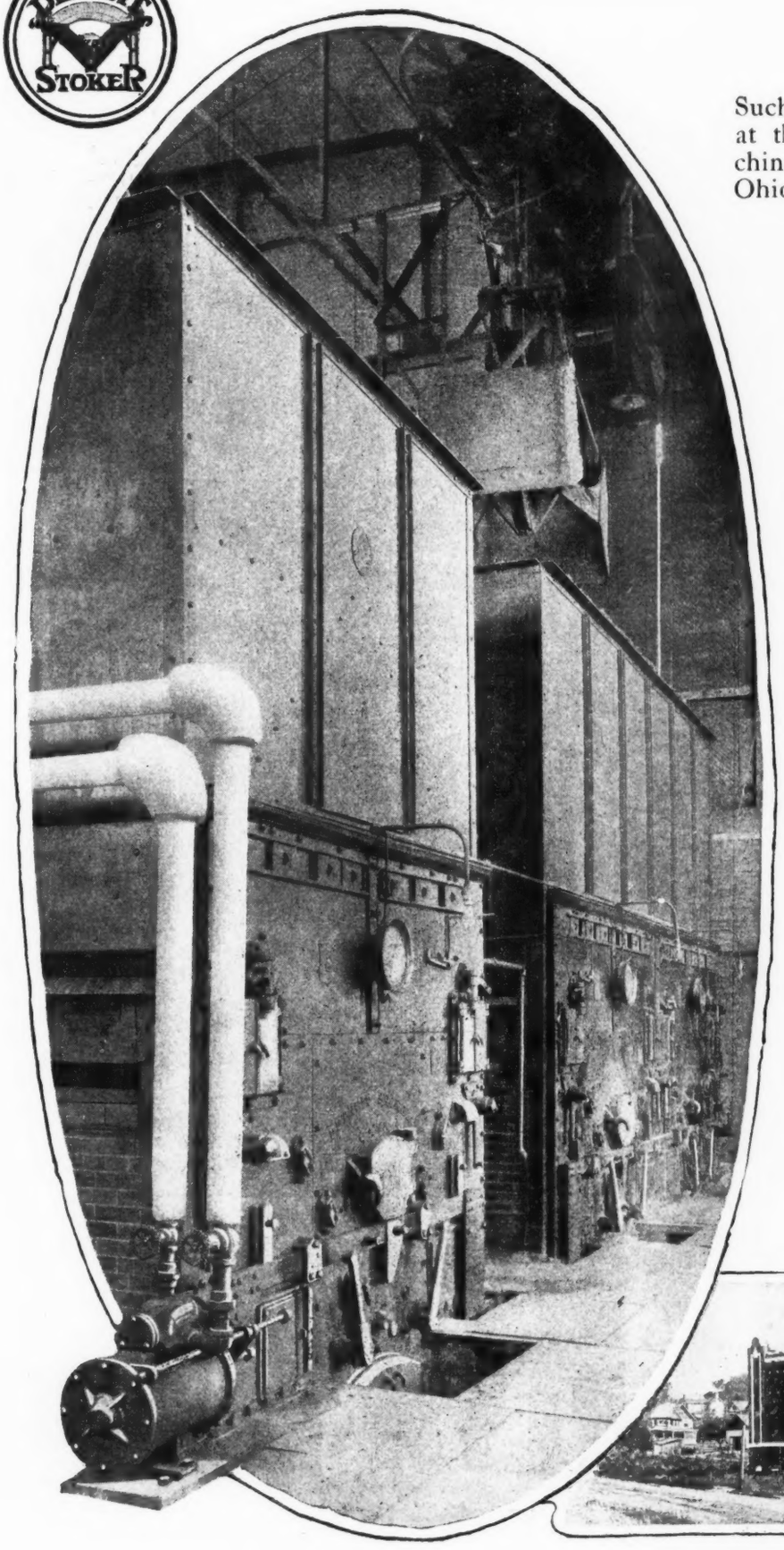
FULLER-LEHIGH CO. Fullerton, Pa., U. S. A.
25 Victoria St., Westminster, London, S. W. 1, England

Where 4 Were, 3 Are

Same load, same coal, same attention, yet 3 boilers do the work of 4 at the Tippecanoe, O., power plant. Armstrong Grates are the answer. Saved their cost in 4 months. **Write us.**

The Armstrong Mfg. Co., Springfield, Ohio

No Stoker Repairs in Two Years



Such is the record established at the R. K. LeBlond Machine Tool Co., at Cincinnati, Ohio,

DETROIT "V" Type STOKERS

Next to maintained economical combustion and quick response to changing load demands, the simple rugged construction of these natural draft stokers stands out supreme.

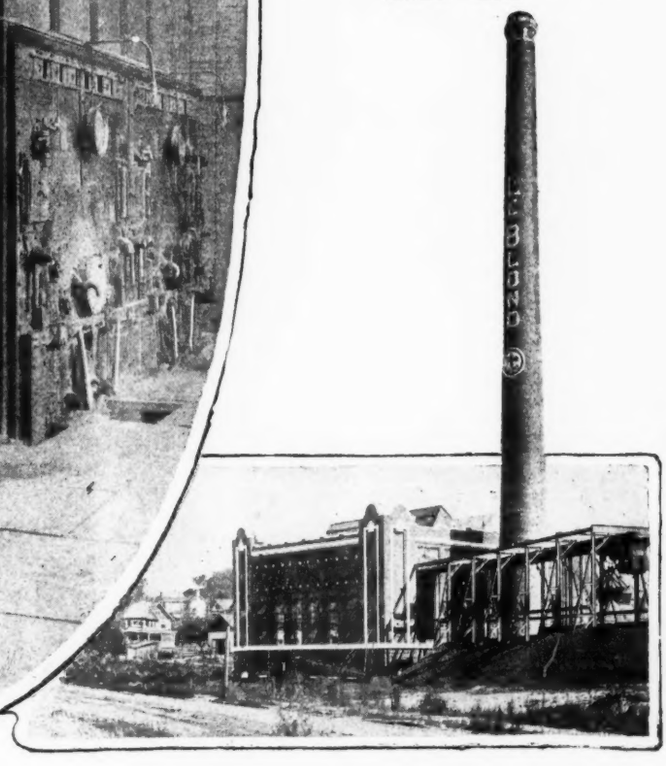
Every part is designed for strength and proportioned to eliminate warping under heat. The assembly provides ample movement for expansion, so that broken stoker parts are a rarity even under the hardest driving.

Detroit Stokers have proved their ability to reduce steam cost.

Ask us to send Catalog "P"

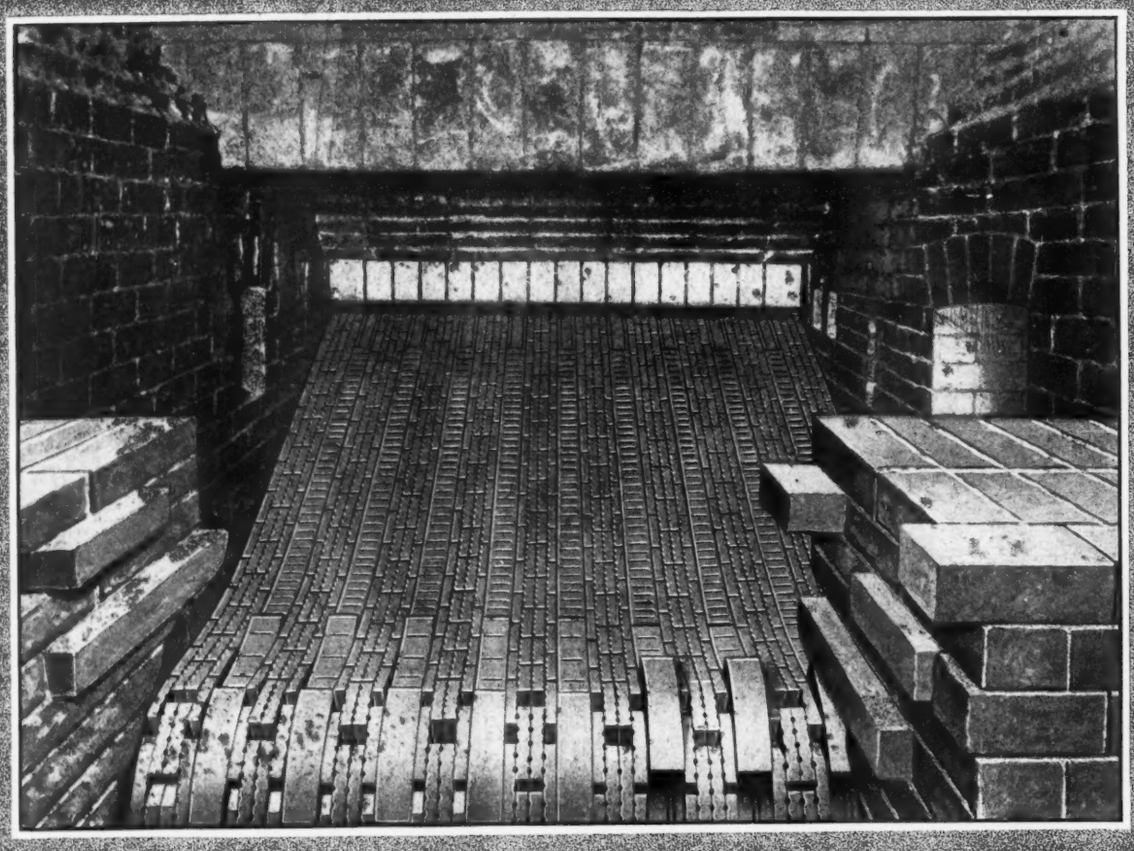
Detroit Stoker Co.
Detroit, Mich.

BRANCHES:
Chicago Cincinnati Pittsburgh Philadelphia Cleveland New York Atlanta Boston



THE STOWE STOKER

Employing Mechanical Draft



LACLEDE

A BUSINESS INSTITUTION

Forced-Draft, Conveyor Feed

—*The Scientifically-Correct Stoker Principle*

The engineering profession in general has always admitted the fundamental superiority of progressive feeding, or more properly, the *conveyor* feeding principle. What shortcomings this principle may have had are now entirely overcome by the application of forced draft.

In this engineering triumph—*the forced-draft, conveyor-feed* stoker—capacities of 300% are an every-day occurrence. Economies after deducting for auxiliaries slightly *excel* those of any other forced-draft type. Flexibility sufficient for all practical purposes is obtainable. Coking coal may be burned successfully.

With these fundamental facts demonstrated, it it obvious that such things as the ease in handling, absolutely automatic operation, absence of clinker and perfection of ash disposal put this type of stoker unquestionably in the foreground.

THE STOWE STOKER is destined to dominate this field because:

(1) A single Stowe Stoker can be used for units up to 1500 H. P., thus doing away with the center fire wall.

(2) Graduated air spaces are substituted for the complicated arrangement of various air pressure compartments.

(3) Drippage, instead of clogging air passages, falls into a pit provided for that purpose.

(4) It is the *only* conveyor feed built on a decided incline and therefore excels in strong ignition temperatures.

(5) It is the *only* conveyor feed that holds the nearly spent fuel back on the grate until every bit of combustible is consumed.

(6) There are no air ducts in the firing aisle.

In selecting your forced-draft, conveyor-feed stoker, keep in mind these outstanding advantages of the Stowe Stoker.

Branch Offices:

CHICAGO, 1366 Peoples Gas Bldg. PITTSBURGH, 901 Oliver Bldg.
NEW YORK, 504, Fifty E. 42nd St.

Agents:

PHILADELPHIA, PA.
A. C. Warner Co.,
Bulletin Bldg.

KANSAS CITY, MO.
Thermal Efficiency Co.,
1210 Scarritt Bldg.

CHARLOTTE, N. C.
J. R. Purser,
406 Com. Bank Bldg.

DENVER, COLO.
Schwarz Eng. Co.,
310 Mack Bldg.

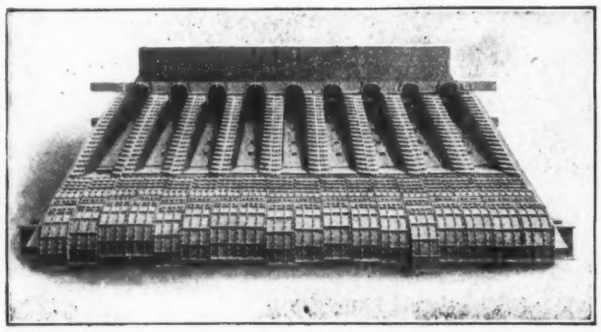
WINNIPEG, CAN.
Wm. A. Goold,
701 Merch. Bk. Bldg.,

MONTREAL, CAN.
John C. Russell,
109 Place D'Youville

D131

CHRISTY

FOUNDED 1844 ST. LOUIS



Riley Stoker Grate Construction

Each and every line of grates, extending from the front to the rear, can be operated independently of all others.

RILEY UNDERFEED STOKERS

It is therefore possible by changing the length of movement of one or more of these grate sections—to alter the condition of the fuel bed in any one spot, in front or back, without affecting the general condition of the fire.

A Riley fuel bed—means better operating conditions—higher efficiency—greater capacity—less fuel and labor—and reduced maintenance.

Catalog P-6 explains the live grate construction.

Sanford Riley Stoker Co.
Worcester, Mass.

THE following reasons explain why the CYCLONE Grate excels in economy—why it *saves coal.*

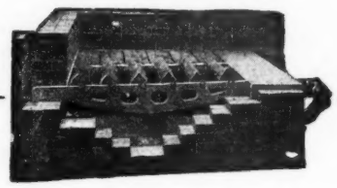
Because it cuts off the ash from the bottom of the fire.

Because it settles the fuel bed, free from thin spots.

Because it maintains an even, steady draft.

Write for further details

Cyclone Grate Bar Co.
Buffalo, N. Y.

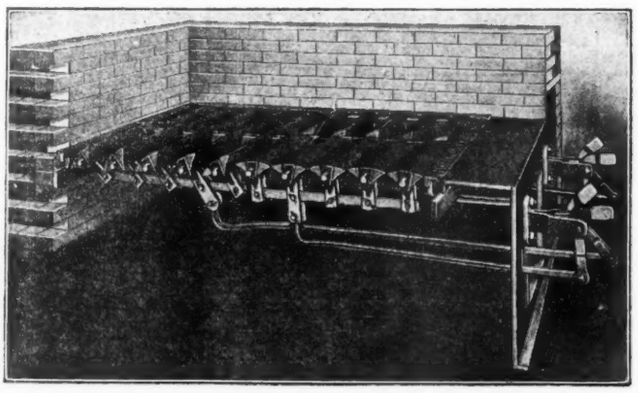


NEEMES Grates afford complete combustion in every case, especially where cheaper fuels are used. They shake the ashes, cut the clinkers and dump the fire—thereby consuming less of the fireman's time. Write for further details.

NEEMES BROTHERS
41-49 Adams Street, Troy, New York

Manufacturers of Round and Square Grates

Babcock & Wilcox, Ltd., Montreal, Canada, Sole Makers for Canada. Burke Engineering Co., 525 Industrial Building, Providence, R. I., Sole Agents for the New England States.



NATIONAL STOKER

The National hand-operated Stoker withstands varying temperature and mechanical wear caused by the movement of the fuel. It supports, without sagging, the fuel bed in which the combustible of the fuel is gasified either by complete or partial combustion. The National Stoker promotes the mixture of the combustible gases with the entering air. The fuel bed is sloped so as to facilitate the feeding of coal down to the lower end, where means are provided for discharging the ash without admitting excessive air.

THE M. A. HOFFT COMPANY
INDIANAPOLIS - - - INDIANA

4

MODEL AUTOMATIC SMOKELESS FURNACE

Burns the cheapest coal at high efficiency.

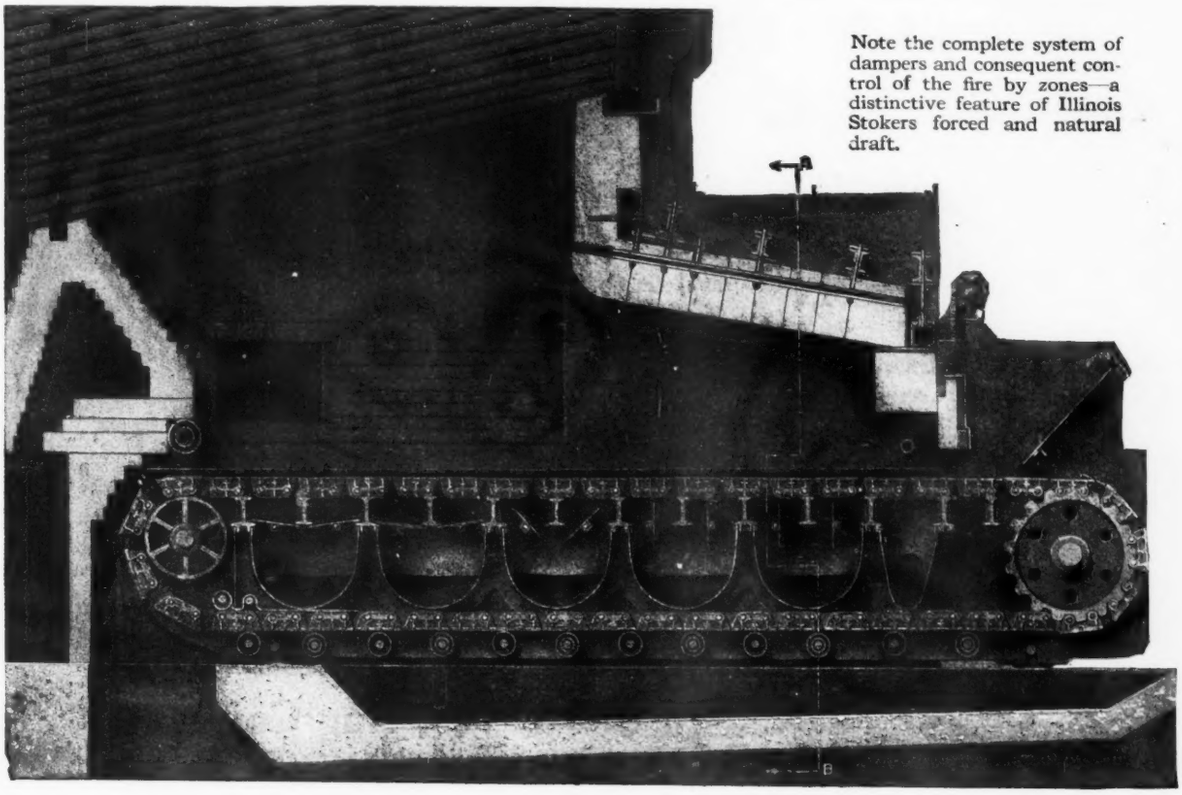
Model—Chicago Chain Grate. Model—Acme Engine.

THE AUTOMATIC FURNACE COMPANY
Dayton, Ohio

INSTALL

FILES STOKER Hand Operated

THE FILES ENGINEERING CO., Inc., Providence, R. I.



Note the complete system of dampers and consequent control of the fire by zones—a distinctive feature of Illinois Stokers forced and natural draft.

Greater Flexibility—Capacity—Efficiency

—*A Result of Perfected Air Control and Mechanical Ignition.*

THE ILLINOIS air control system has given the chain grate new possibilities. Every section of the grate surface can be supplied with just the proper draft to suit the firing characteristics of the many grades of coal encountered. This greatly increases the flexibility of the chain grate, not only in ability to meet and sustain sudden peak loads, but also in ability to bring out every heat unit of the lowest grades of coal—even when boilers are operated at high overloads.

The ***Illinois*** system of mechanical ignition, consisting of induced draft through the tuyere nearest the fuel gate, means high ignition rates while burning high moisture coals—anthracite, culm, coke-breeze or high moisture lignites. Mechanical ignition permits higher ratings with these coals than can be secured with ignition arches.

The air control feature is an outstanding advantage of both the forced and natural draft types of ***Illinois*** Stokers. It greatly increases the efficiency of the natural draft type. Added to forced draft, it permits forcing the boilers far beyond the limits of ordinary stoker operation.

THE CHAIN GRATE—

does not form clinker
requires least labor
operates continuously without stopping to clean fires
dispenses with all auxiliary apparatus ordinarily used to handle clinker accumulations

A complete explanation of both types of Illinois Stokers is contained in catalog "L." Write for it.

Illinois *Chain Grate* Stokers

Type "G" FORCED DRAFT ***Type "A"*** NATURAL DRAFT

Since our experience has covered the installation of both forced and natural draft chain grates, we can advise you accurately as to the proper type for *your* plant.

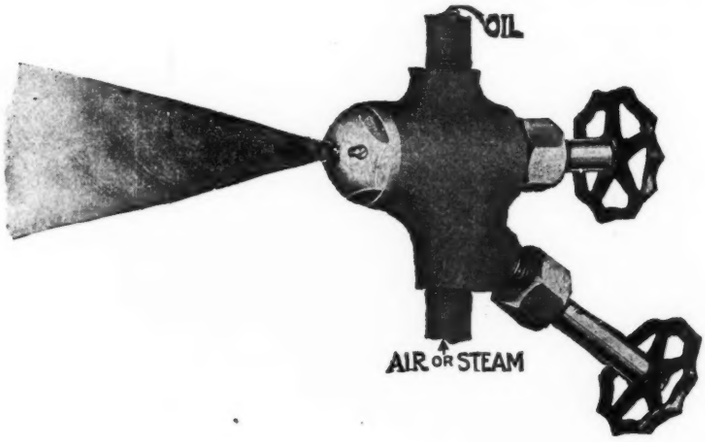
Don't Worry About Coal!

IT is unnecessary, if you will adopt

ANDERSON Oil Burners

Begin now—by burning gas or oil, or a combination of the two under your boilers—and forget about coal.

You take no chances, because you can give the burner a thorough tryout, before you buy it. A 10% fuel saving over any other burner is guaranteed.



Write for particulars of our free trial offer

N. C. Davison Gas Burner & Welding Company
3143 Penn Ave., Pittsburgh, Pa.

ECONOMIC Carling BLOWERS INDEPENDENT

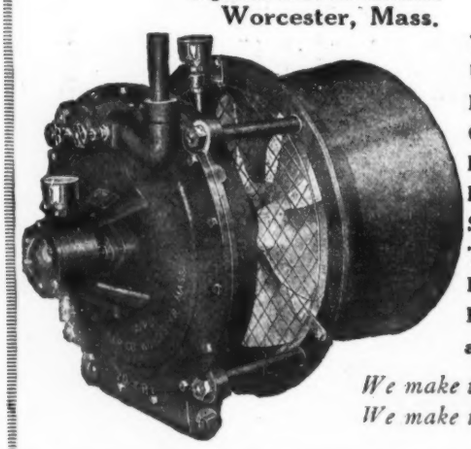
Carling Turbo Blowers

For burning the lowest grades of coal successfully, getting all the heat value from the fuel. For positive draft with Automatic Control and steady steam pressure. For obtaining the ultimate capacity from the boiler.

Carling Blowers are low in first cost, easy to install and make a quick return on the investment. We will be pleased to show you why it pays to use Carling products.

Write today. TRY AT OUR EXPENSE.

Carling Turbine Blower Co.
Engineers and Manufacturers
Worcester, Mass.



Turbine Undergrate Blowers, Centrifugal Blowers and Exhausters, Small Power Turbines, Damper Regulators and grates.

We make them safe
We make them strong

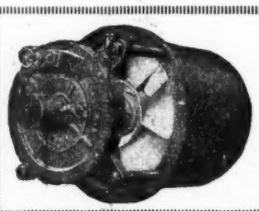
GREEN'S
HI-EFFICIENCY HI-SPEED
RADIAL FLOW FANS

Let them supply your forced draft at a large saving in operating and upkeep cost.

Built in sizes to handle from 1600 to 275,000 cu.ft. per minute at pressure up to 7 inches of water.

Learn why they are more efficient. Write for Bulletin No. 152.

THE GREEN FUEL ECONOMIZER CO.
BEACON, N.Y.



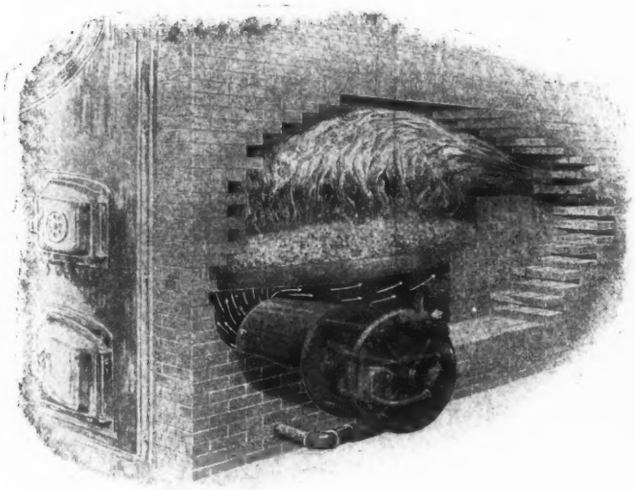
POWER SIMPLEX
Turbo-Blowers
Turbines—Damper Regulators—Turbo Pumps
Power Turbo Blower Co.
347 Madison Ave., New York
710 Witherspoon Bldg., Philadelphia
140 S. Dearborn St., Chicago
Agents for Canada: The Canadian Stoker Co., Ltd., Galt and 15 Rusholme Rd., Toronto, Ontario, Canada.

OIL BURNERS
WRITE FOR BOOKLET "P"
TJ TRADE MARK Reg. U.S.Pat. Off.
Tate-Jones & Co. inc.
FURNACE ENGINEERS Pittsburgh, Penna. ESTABLISHED 1898
New York Chicago Buffalo San Francisco St. Louis

the coal conserver—

The **Wing Turbine Blower**

releases the full heat energy from the poorer grades of fuel as well as from the best. It supplements the insufficient draft obtained from small stacks, increasing the amount of air to that required to carry high overloads.



Have you considered the question of draft in connection with your fuel consumption?

WING TURBINE BLOWERS will maintain an even ash-pit pressure under the entire fuel bed, insuring complete combustion. They will give the required air supply at all times and under all load demands.

Wing Turbine Blowers not only conserve coal. They effect further economies by making possible the operation of boilers at the highest output obtainable. Equipped with Wing Blowers higher overloads can be carried with maintained steam pressure at *increased economy.*

Ask our engineers to show you the way to this economy. They will gladly make recommendations for the proper application of Wing Blowers to your boilers.

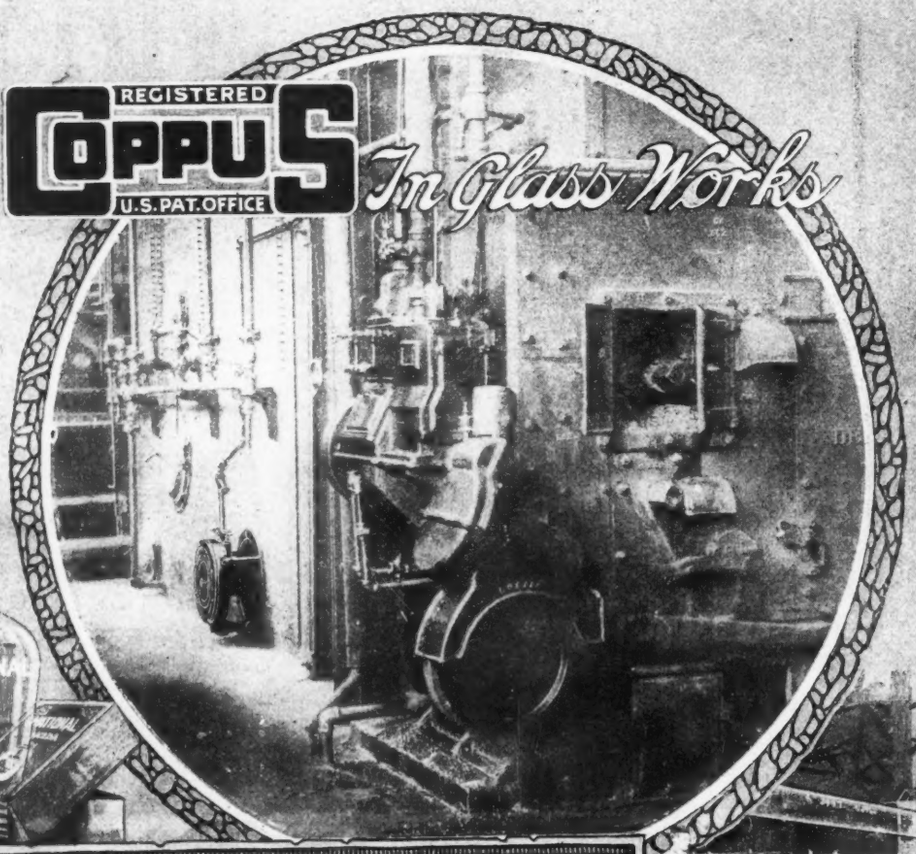
Write for Bulletin 47.

L. J. Wing Mfg. Co.

9th Avenue and 13th Street, New York

Manufacturers of Blowers, Damper Regulators, Ventilating Fans, Pressure Blowers, Vacuum Pumps and Small Turbines

REGISTERED COPPUS U.S. PAT. OFFICE *In Glass Works*



In the Glass Division Power Plant of the National Lamp Works out in Cleveland, Ohio, they burn gas coal screenings and producer tar—difficult fuel to burn economically. Yet with the 4—18-in. COPPUS Turbo Blowers which they operate, full steam pressure is maintained in their 4—250-hp. Stirling Boilers—and cheap fuel is efficiently burned. Without these blowers, one of which is shown above, additional boilers would have been necessary last fall. With their aid, however, the heavy plant load is easily handled.

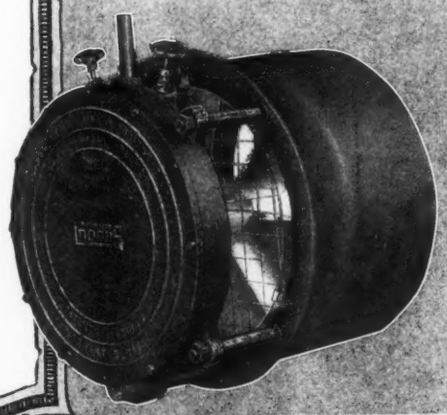
Before the National Lamp Works installed COPPUS Blowers, a careful investigation satisfied them that for efficient operation, low steam consumption, and sturdy dependability, COPPUS Blowers stand in a class by themselves. And after practical proof that COPPUS Blowers are all that is claimed for them, Mr. Bretz, Plant Superintendent, expresses himself as "highly pleased with them." In the National Lamp Works, as in thousands of plants in every industry, COPPUS Blowers have proved profitable investments.

Why not find out exactly how and why "COPPUS Equipment can save you money?" Write us and our engineers will help you solve your combustion problems. If you haven't a copy of Blower Catalog write for one today.

The Coppus Engineering & Equipment Co.

Manufacturers of COPPUS Turbo Feed Pumps and COPPUS Turbo Blowers

350 Park Avenue, Worcester, Mass.



COPPUS TURBO BLOWER

OXY-BLAST—A FUEL ECONOMIZER

Of special interest to plant managers, engineers, firemen and others is our booklet "Scientific Combustion" which will be mailed on request.

POWER plant owners that have their boilers equipped with Oxy-Blast note a material saving in their fuel bills without physical effort on the part of the boiler room operators.

Differing from the average boiler equipment, installed for efficiency and economy, Oxy-Blast does not represent a large investment. There are no upkeep charges to figure in its cost, as it requires virtually no attention on the part of the fireman after it is installed. It is effective on any high pressure boiler of standard make; is simple in construction, easy to install, does not require extra space, and is automatic in operation and control. The average installation has been self supporting and can usually be charged off with a year's usage due to the saving it effects.

An important feature of Oxy-Blast is that it permits the use of cheaper grades of coal. Where hard coal is used, soft coal may be substituted, and the same efficiency obtained. The strictest smoke ordinance can be complied with by using Oxy-Blast, as it eliminates smoke by consuming the volatile elements which arise from fuel that is not receiving absolute combustion at the time of stoking.

Ordinarily there is a loss as high as 40% of the heat value of coal at the time of stoking due to the escape of inflammable gases and other heat elements which Oxy-Blast consumes. In the course of a year this eliminated waste will represent a considerable saving.

The increased supply of oxygen which produces instant combustion at the time of stoking, keeps the firebox at a high temperature and does not allow the steam pressure to vary. Important also is the fact that thinner fires can be carried and steam raised quicker by the use of Oxy-Blast, affording an additional saving of fuel.

The life of Oxy-Blast is indefinite. Installations made seven years ago are in perfect working order. It has been commended highly by users in power plants, public buildings, schools and office buildings. On two municipal installations in Rochester, N. Y., the average yearly saving in fuel was over $3,500.00 over a five year period.

Boiler equipment, mill supply and machinery houses are invited to inquire about our attractive contracts on the sale of Oxy-Blast in restricted territories.

GENERAL FUEL SAVING CORPORATION

ROCHESTER, N. Y.

McGowan Power Pumps

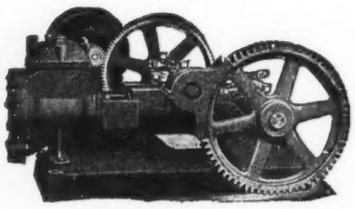


FIG. 383
Center Packed Plunger Pump
Top Motor Mounting

ABSOLUTE RIGIDITY IN POWER FRAME

The compact design, observed in the construction of McGowan Duplex Power Pumps adapts them for installation within less space than required for any other design of the Displacement Type of Pump, having corresponding capacity, therefore their application for mine service or other installations affording limited space.

To those interested in the purchase of Power Pumps our Bulletin No. 80 will be found of value in selecting sizes and types suitable for various conditions of pumping service.

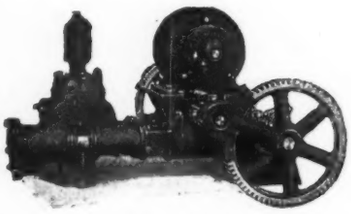
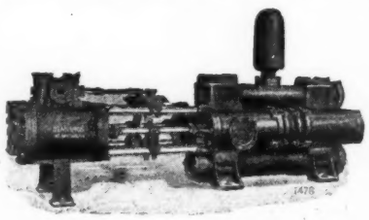


FIG 404
Packed Piston Pump
Side Motor Mounting

The John H. McGowan Co.
Cincinnati, Ohio, U. S. A.

The Valve Movement of Dean Bros. Durable Duplex Pump is the Most Important Improvement that has been made on a Duplex Steam Pump for Twenty-five Years

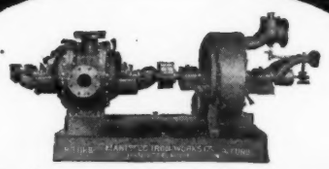


Send for Catalog 109.

New York Sales Office, 141 Broadway

DEAN BROS. STEAM PUMP WORKS. INDIANAPOLIS.
HOT IN THE PUMP TRUST.

R.TURB.



R.TURB. CENTRIFUGAL PUMPS AIR PUMPS
MADE BY MANISTEE
ROTARY JET CONDENSERS

Manistee Iron Works Co. MANISTEE, MICH.

LEA-COURTENAY PUMPS

Centrifugal pumping machinery for every kind of pumping service.

Lea-Courtenay Co.
9 Maine St., Newark, N. J.

The Dourte Pump

—valveless—

If you handle thick liquids or liquids with solids in suspension, pump them with the Dourte.

THE MINE AND SMELTER SUPPLY CO.
New York Office: 42 Broadway.
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Davidson Automatic Feed Pumps and Receivers

drain heaters, separators, radiators, and pipe lines *the positive way.* Write for Catalog

M. T. DAVIDSON COMPANY

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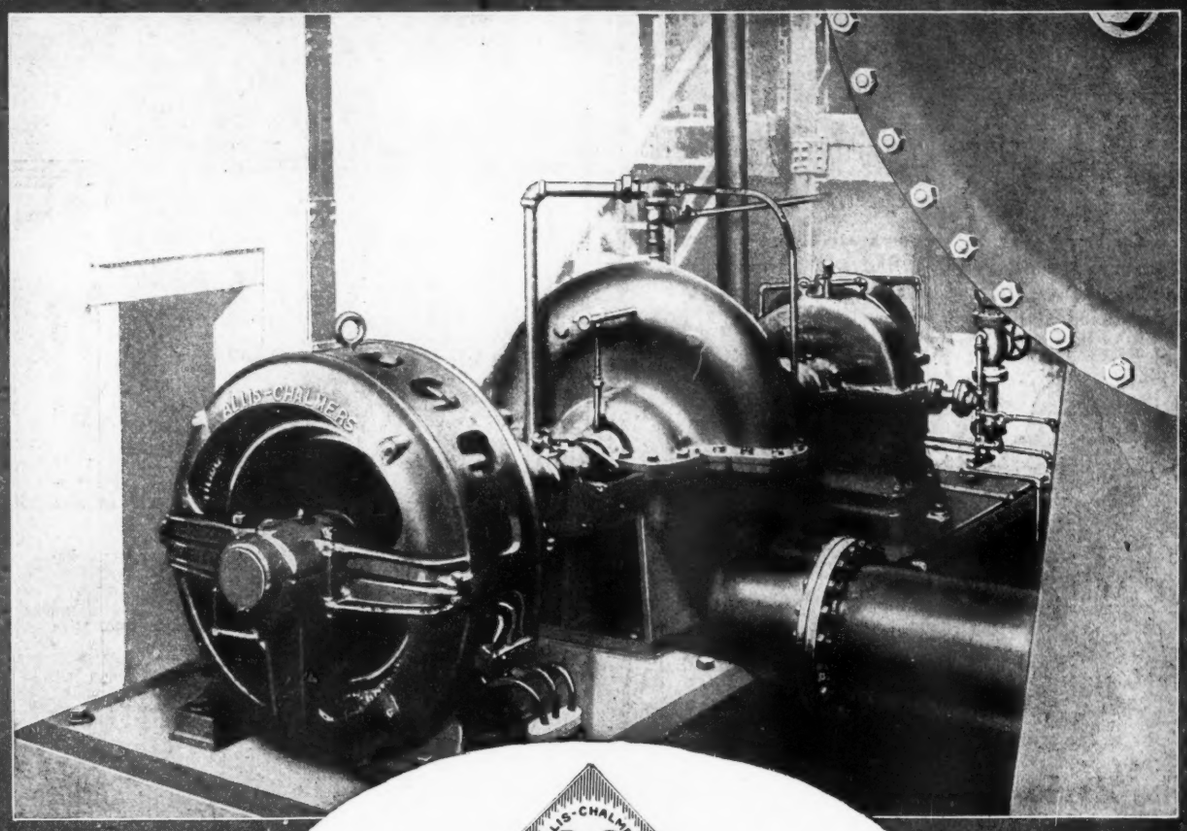
Works: 43-53 Keap Street, Brooklyn, N. Y. 32 Oliver Street, Boston, Mass. 147 North 7th Street, Philadelphia, Pa.

Pennsylvania

Guaranteed Pumps and Compressors

Pennsylvania Pump & Compressor Co.,
Easton, Pa.



Circulating Pump with motor and impulse turbine drive

This Allis-Chalmers Centrifugal Pumping Unit, installed in the American Public Utilities Co.'s plant, has two kinds of drive, permitting the pump to be driven direct by the motor from one end or through gears by an impulse turbine on the other end. It is a 20-inch, type "S" Allis-Chalmers circulating pump, 10,500 G.P.M. working under a 25-foot head, and like all Allis-Chalmers pumps, is giving satisfactory service.

Not only do Allis-Chalmers pumping units possess every improvement in design and construction, but they have a big advantage over other units—the pump and motor are built by the same concern. This centers all responsibility for satisfactory operation in one concern.

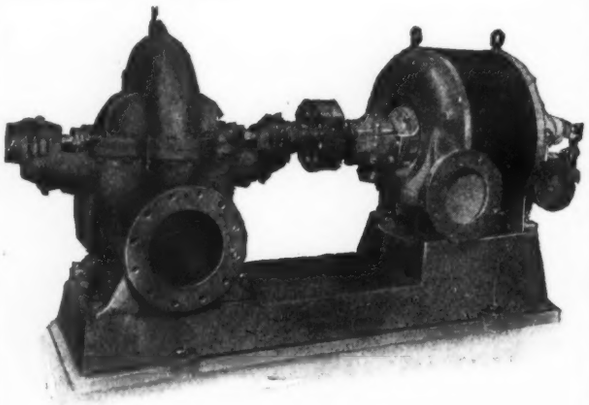
Our Engineering Department will gladly assist on any pumping problem. We build a complete line of Pumping Machinery and are pleased to send Bulletins on any special type of pump upon request.

Allis-Chalmers Mfg. Co.
Milwaukee. Wisconsin

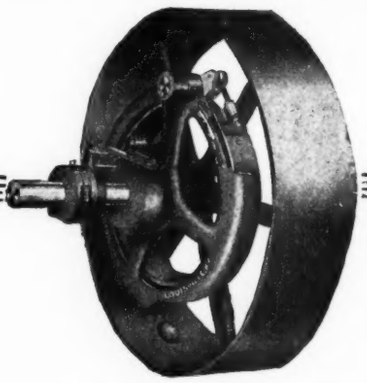
EARLE
CENTRIFUGAL PUMPS

For Service Where Quality Counts

Even for low heads, with comparatively uneconomical turbine speeds, you will find a Turbine Driven Centrifugal Pump less of a "steam eater" than your old-fashioned Duplex.



The Earle Gear & Machine Co.
4709 Stenton Ave., Philadelphia, U. S. A.



Avoid Clutch Troubles

Install the Caldwell Friction Clutch in your plant and you can be sure of steady, uninterrupted, twenty-four-hour-a-day clutch service without a hitch.

The Caldwell Clutch is simple, compact and safe because it is built on correct mechanical principles. One Lever Controls It; One Screw Adjusts It. No trouble, no costly interruptions, always on the job. The brake band grips the entire circumference of the friction ring and transmits the maximum power with minimum effort.

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Caldwell
FRICTION CLUTCHES

C. H. WHEELER
Condensing Equipment

Designed to meet every modern requirement for high vacuum. Fitted with

"RADOJET" Ejector Air Pumps

that contain no moving parts and require no oiling or repairs. The latest advance in efficient practice. Proved by more than three years' successful operation. Write

C. H. Wheeler Manufacturing Co.
Philadelphia, Pa.

New York, Boston, Chicago, Pittsburgh, Charlotte, New Orleans, San Francisco and Seattle

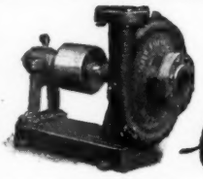
Save Money in Heating Your Plant

Carry a steady 20-inch vacuum on your lines with a

Thompson Vacuum Pump

Uses less power due to absence of valves, gears and sliding wings. Will punch against 20 lb. pressure. Write for Bulletin B-3.

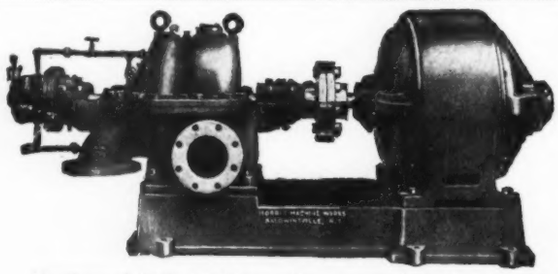
THOMPSON MFG. CO.
Des Moines, Iowa



Centrifugals

We specialize on single stage low head centrifugal pumps.
Ask for Catalog

TABER PUMP CO.
297 Elm St., Buffalo, N. Y.

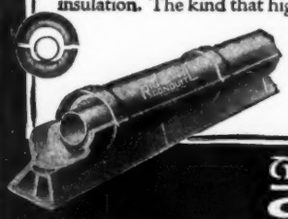


Horizontal Split Multistage Pump. This is but one of our complete line of Centrifugal Pumps. Have you our power plant pump catalog?

Morris Machine Works
Baldwinsville, N. Y.
Branches in Principal Cities
Since 1864 Builders of Dredges, Centrifugal Pumps, Steam Engines

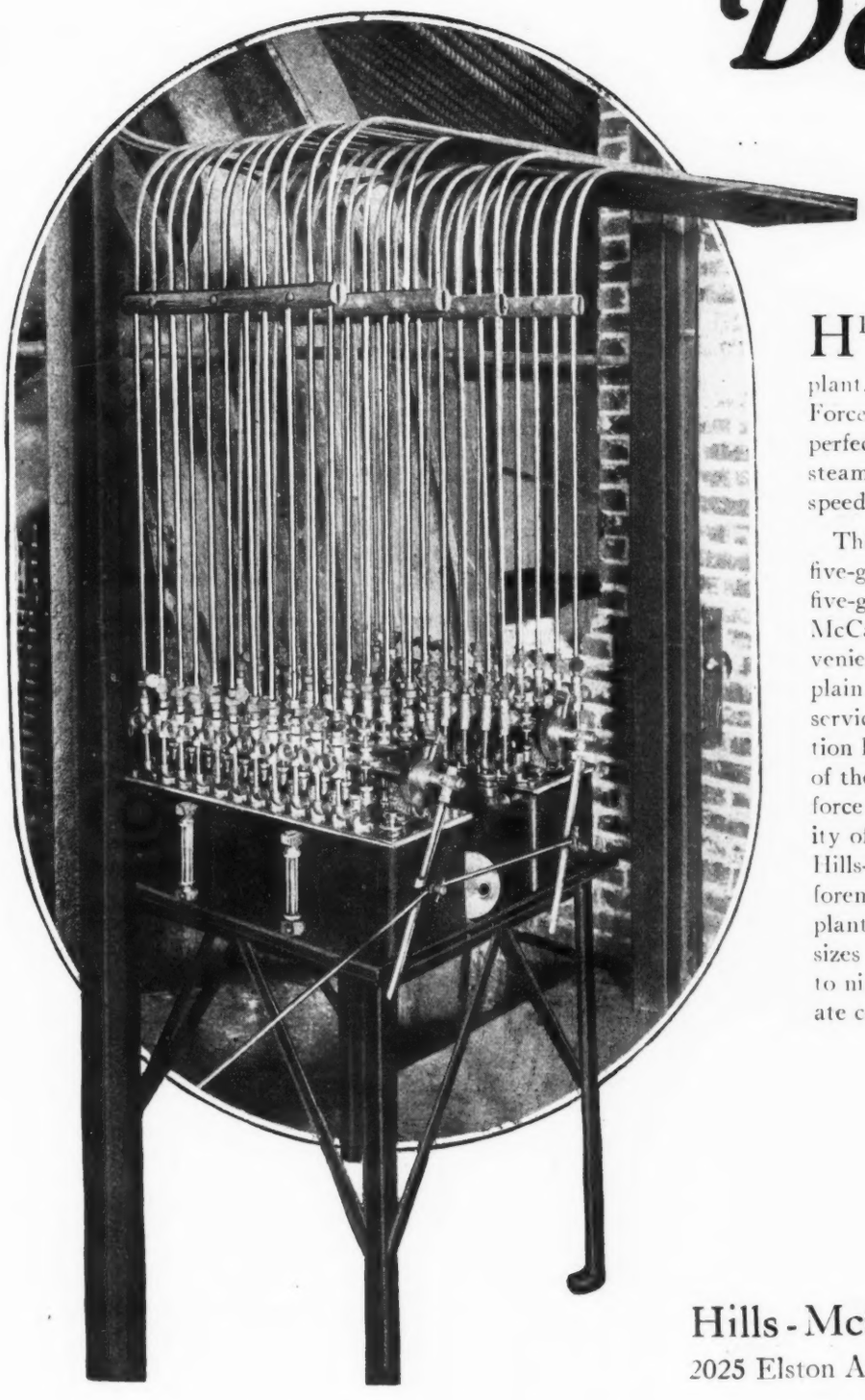
FOR UNDERGROUND STEAM OR HOT WATER PIPES
THE SIMPLE
RIC-WIL METHOD

It is a clean-cut, complete and practical method of pipe insulation. The kind that highly trained technical men and practical operating engineers both approve. Bulletin No. 1 explains RIC-WIL simplicity and other features.
Write for it to-day.



The RIC-WIL COMPANY
CLEVELAND

LUBRICATION *De Luxe*



HERE is supreme concentration of lubrication in a great power plant. These two Hills-McCanna Force Feed Oil Pumps are supplying perfect lubrication to twenty-two steam cylinders and twenty-five high speed bearings.

This combination consists of one five-gallon, twenty-two feed, and one five-gallon twenty-five feed Hills-McCanna lubricator. They are conveniently placed in engine room in plain view of engineer. In years of service practically no repairs or attention has been necessary. It is typical of the performance of Hills-McCanna force feed oil pumps, and the versatility of the line. For twenty-five years Hills-McCanna pumps have been foremost in serving important power plants the country over. Range of sizes reaches from a pint single feed to nine gallon forty-four feed. Separate compartments for different oils.

Write for bulletins.

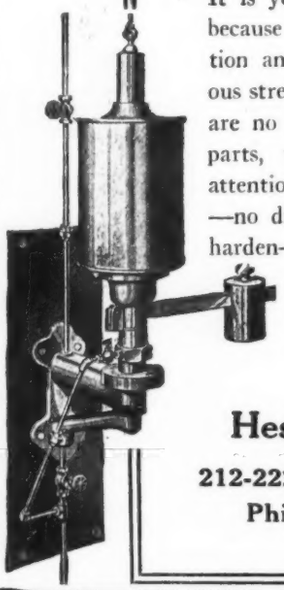
Hills-McCanna Company
2025 Elston Ave. :: :: Chicago

Hills-McCanna

The KELLUM

Damper Regulator assures safety

Circular sent on request



It is your assurance of safety, because of proper draft regulation and elimination of injurious stresses in the boilers. There are no pilot valves, with their parts, which require constant attention—no water cylinders—no diaphragms to crack and harden—no gauges to be reset. Just a cast iron weight pushed down by gravity—or up by steam.

Hess & Barker

212-222 South Darien St.
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Automatic Injectors Are Dependable!

Unusual conditions or ordinary conditions are all the same to Penberthy Injectors. They are always ready and willing. — and they do the work.

That's because they pass many severe tests before leaving the factory. Good material, good workmanship, and, above all, good design, insures the Penberthy for any emergency.

There's a heap of information in our catalogue about injectors. Write for a copy today—free.

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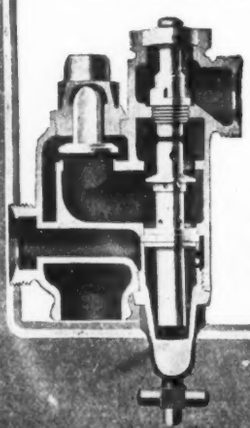
"U.S." AUTOMATIC INJECTORS

Advantages of the Drip-Cock

A distinctive feature of the U. S. Automatic Injector is the Drip-Cock (see cut) which has the following special advantages:

1.—It drains the Injector when not in use, and thus prevents freezing.
2.—By leaving it open you can start Injector even though the check valve leaks. This is impossible without Drip-Cock.
3.—By opening Drip-Cock you can start with lower steam.
4.—By leaving it open, when not in use, it prevents suction pipe from getting hot, or jet from liming up when steam or check valve leaks.
—It enables you to take hot water out of a hot suction pipe on a long lift.
—It is always handy for drawing hot water for any purpose when injector is working.



AMERICAN INJECTOR CO.
"G"—179 14TH AVENUE
DETROIT, MICH.

BERNITZ METHOD

U.S. PATENTS PENDING

Permits 100% Furnace Operation

Without injury to furnace walls—furnace can be operated at full capacity—continuously—by the Bernitz Method (U. S. patents pending) of furnace wall construction. *This method greatly increases the life of fire walls.*

Send for particulars.

Bernitz Furnace Appliance Company
15 State Street, Boston, Mass.

106-18

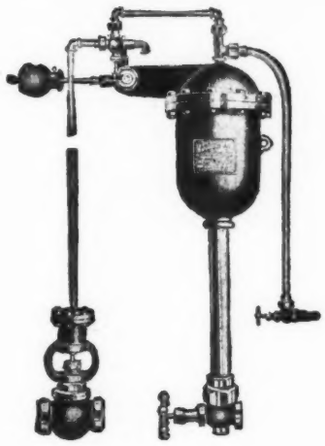
The BLACKBURN-SMITH FEED WATER FILTER and GREASE EXTRACTOR

removes oil, greases and dirt from boiler feed water made up of condensed exhaust steam and dirty raw water.

Reduces coal and water bills.

Ask for our free Booklet.

The BLACKBURN-SMITH CORPORATION
107 W. 40th Street, New York



THE VIGILANT Feed Water Regulator, by keeping the water at middle gauge, automatically, all the time—precludes the possibility of an explosion due to low water.

Effects a perceptible coal saving besides.

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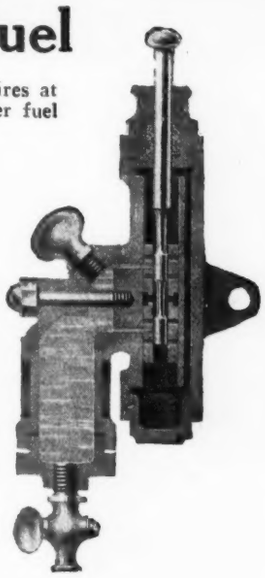
The Chaplin Fulton Mfg. Co.
28-34 Penn Avenue, Pittsburgh, Penna.
Also Manufacturers of the Fulton Pump Governor

To Save Fuel

Correct air supply to your fires at all loads will result in better fuel economy.



R-K

Fan Engine or Damper Regulators

accurately control the draft in accordance with the boiler and furnace load.

Their sensitiveness is positively maintained in service due to the self-lubricating pilot valves that cannot stick or corrode. The oil is continuously forced against the sliding surfaces by water displacement.

Automatic in operation. Simple in design and completely dependable.

Ask our engineers to furnish details

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"Launder" Dirty Oil and Reduce Power Cost

Filtering oil gives several gallons for the price of one. Better lubrication and a cleaner engine room are other factors.

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You don't need an expensive, elaborate equipment. The S. and W. Oil Filter embodies everything needed; and is so simple it never needs repairs and seldom needs cleaning.

Use one 30 days free. If it don't do things, send it back. You can't lose.

Seehausen, Wehrs & Co.
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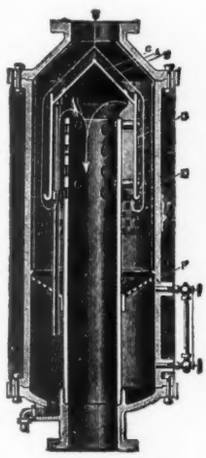
S. and W. Oil Filter



Not the Cheapest in Price— BUT "The Cheapest to Buy"

In assured delivery of dry steam at all times and the resulting operating economy of your turbines, engines, pumps and compressors.

Sweet Direct Separators

will net you a bigger return per dollar invested than separators that you can buy for a much lower price. In design, high-grade materials and workmanship the Sweet is unexcelled.

The moisture is separated by capillary attraction, and the sudden reversal of the steam current. The design is right—and has proved its high efficiency by years of continuous hard service.

Write us for full details

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Wise Men Use Indicators

Such Professors of Engineering as Breckenridge, Lucke, Young, Marks—all of the BIG MEN—use indicators for indicating engines, pumps, compressors, ammonia machines, etc. To them the indicator is "worth its weight in gold." This has been true ever since the time of James Watt.

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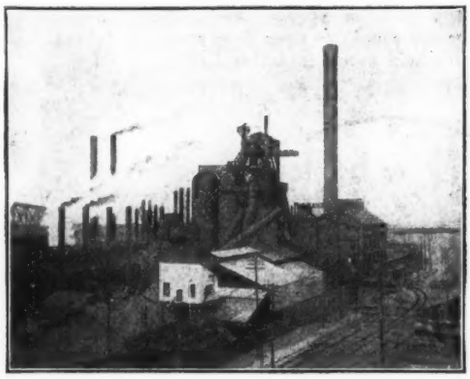
BUILDERS VENTURI IRON FOUNDRY



Essential to the Steel Industry

The large steel mills in the Pittsburgh District require an enormous amount of water for cooling and washing purposes. This water is taken directly from the river without any attempt at filtration, other than a coarse screen. As a result a great deal of sediment is passed through the pumps rapidly reducing their efficiency.

VENTURI METERS

are regarded by the engineers in this industry as essential for keeping down the cost of operating the pumps and keeping up the quantity of water.

The Venturi Meter Tube with its absolutely smooth, unobstructed walls is not affected by the mud or silt from the river and it discloses immediately any falling off in the efficiency of the units.

The Venturi is also used in the steel industry to control the amount of water supplied to the furnaces for cooling purposes, and to measure coke oven gas and boiler feed.

Bulletin No. 84 describes the Venturi for cold water and Bulletin No. 86 describes the Venturi for Gas and Air.

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Builders Iron Foundry

"Builders of the Venturi for 29 Years"

Providence, Rhode Island
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E. F. Scott, Atlanta; N. B. Livermore & Co., San Francisco; Northwestern Equipment Co., Portland, Ore.; Allen General Supplies, Ltd., Toronto, Can.; General Supply Co., Ottawa, Can.

60 Days' Free Trial

Franklin Institute Award

Easily read

Equalize Your Boiler Loads

When one boiler delivers more or less than its share, the combined efficiency of the battery drops, and steam costs more.

HAVARD Coal Meters

will accurately meter the coal that is fed to each boiler during each hour, watch or day. They enable you to keep informed on the true performance of every boiler and will soon point out those boilers that are not receiving proper attention by the men, or in which defects are developing.

You can install these efficient meters in your coal chutes at a moderate cost.

Write for full details.

O. D. HAVARD CO.
ALLENTOWN, PA.

"HAMMOND" POWER PLANT WATER METERS

Alberger Pump & Condenser Co.
140 Cedar St., New York City
Boston Philadelphia St. Louis Chicago

THWING PYROMETERS

THERMO-ELECTRIC
RESISTANCE RADIATION
INDICATING AND RECORDING OUTFITS FOR ALL INDUSTRIAL PURPOSES

Thwing Instrument Co., 3351 Lancaster Ave., Philadelphia, Pa.

Erfmann's Boiler Water Controller

a device which the man in the boiler room can use, points to

THE WAY TO PREVENT BOILER SCALE

It tells in a simple test taking only a few minutes, just the amount of soda ash that should be added to your boiler water to prevent incrustation. Write for details.

Neptunus Supply Co., 73 Front St., N. Y. C.

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Pyrometers Thermometers
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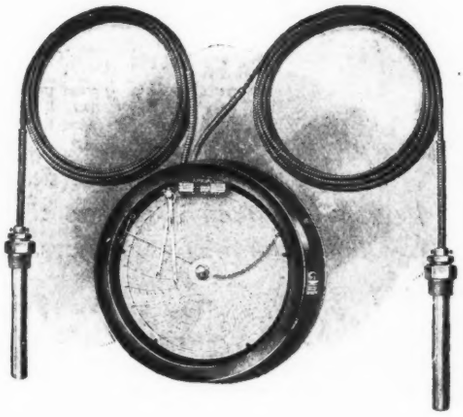

Dirty Economizers!

F you are operating an economizer with your boilers are you quite sure that you are getting all you can out of it? Examine it. Scale and soot will quickly kill its efficiency.

FOXBORO
TRADE MARK

Two-Pen Recording Thermometers

on both water and gases going in and out will enable you to detect instantly when economizer efficiency lags.

They are adapted for any operation where an accurate knowledge of temperatures is vital.

They will stand up and function correctly under the most adverse conditions.

Announcement: We have just published the most complete Thermometer Bulletin ever printed. Eighty interesting pages. More than One Hundred illustrations. And an Index to help you to find what you want when you want it. Ask for E104-1.

THE FOXBORO CO., Inc.

FOXBORO, MASS., U. S. A.

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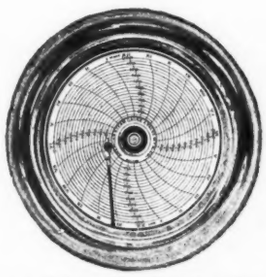
With the daily chart of an

AMERICAN Recording Gauge



the engineer can make comparisons, establish economies, promote efficiency and positively check waste.

Ask for the Bulletin

American Steam Gauge & Valve Mfg. Co.

New York Chicago Boston Atlanta Pittsburgh

KNOWLEDGE IS POWER

THERE is nothing like having an accurate knowledge of the speed of your turbines, engines, motors or shafting. It prevents power waste.

O-Z

60 to 12,000 R.P.M. Hand Tachometer

Tells you at a glance and with unfailing accuracy. Right or left hand revolutions, records any variation in speed, operates at any angle and is not affected by moisture, temperature or magnetism. *Send for circular.*

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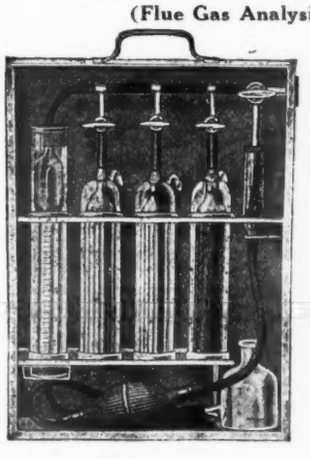
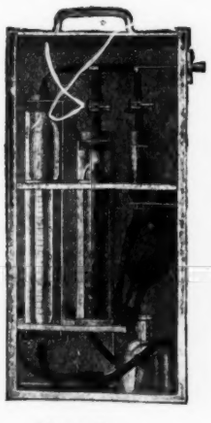
Defender Improved Modified Orsats

(Flue Gas Analysis Instruments)



Model A



Model B

Write for our catalogue, No. 11, showing improvements and additions to the Defender Line of Efficiency Instruments, Damper Regulators, and other appliances for effecting economies in the boiler room. Four models and eight types of Flue Gas Analysis Instruments for reading CO_2, O. and CO percentages and new style cases for mounting Orsats and Gas Suction Pumps illustrated and described therein.

Send for Bulletin No. 400.

Defender Automatic Regulator Co.

St. Louis, Mo.

Unific Brand for pressures up to 400 lbs. Perth Brand for pressures up to 200 lbs.

Ask for the Booklet.

There's Only One Scotch Gauge Glass

But there are scores of imitators. Hence, you should make sure that you get the original and only Scotch Glass—

MONCRIEFF

For *over half* a century it has been the best glass that could be produced from the Scotch Sands—the finest material known for making glass.

If you want the toughest glass and clearest glass in one—insist upon MONCRIEFF.

H. A. Rogers Co.
87 Walker Street
New York

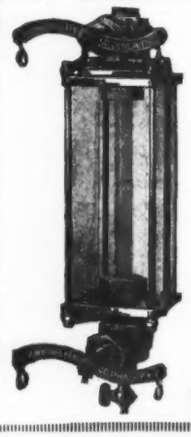
TRIED and PROVEN

Over 30 years of real service has proven the Cyclone Lubricators.

They are made in a variety of sizes and connections and are stocked by all leading jobbers.

Printed matter on request

MICHIGAN LUBRICATOR COMPANY
Detroit, Mich., U. S. A.



The "PBH" Gauge Glass Protector

Glass used is "Safetee Glass," especially prepared to withstand shock of bursting gauge glass and will not shatter nor fly if accidentally injured.

Protector cage brackets fit any make of water gauge. Illustration shows protector attached to a "PBH" chain, quick closing water gauge; an up-to-date combination for safety.

Requires but a minute to attach. In ordering, state distance between inside faces of rod plates on your gauge valves. Satisfaction guaranteed. Prices right.

Patent applied for.

P.B.H. Self-Closing Weighted Gauge Cock

Positively will not leak when closed. Can be instantly opened from the boiler room floor by a pull. When released the weighted lever will instantly close the valve again. The valve pencil is of special design and made of a wear-resisting metal. No regrinding is ever required. When worn it can be replaced at a cost of a few cents.

Write for Descriptive Bulletins.

The PAUL B. HUYETTE CO., Inc., 5 So. 18th St., Suite 25, PHILADELPHIA, PA.

FOSTER SUPERHEATERS

A necessity for turbine protection, engine cylinder economy, and utilization of superheat for all its benefits

POWER SPECIALTY COMPANY, 111 Broadway, New York

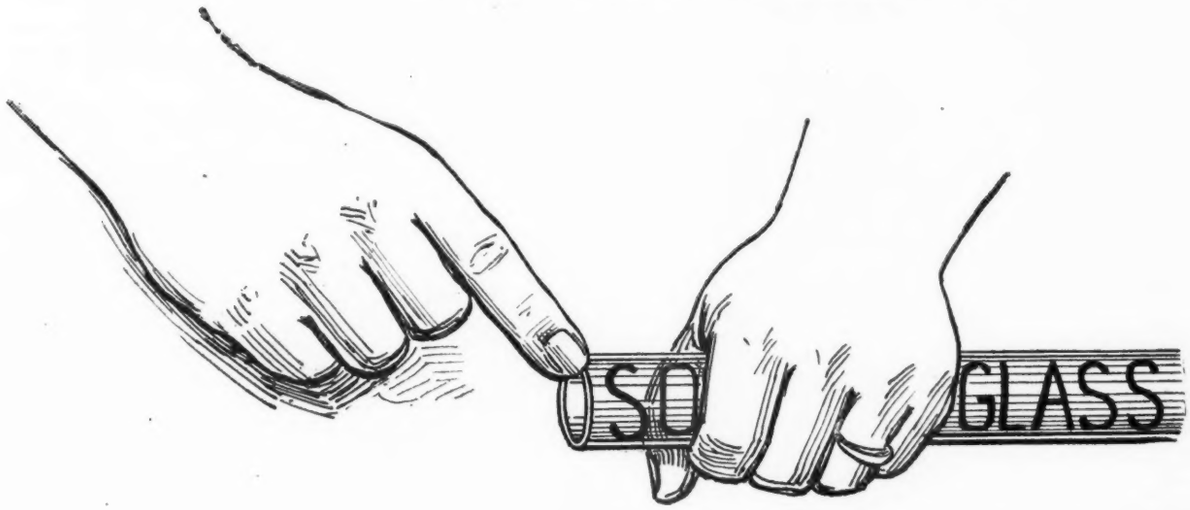
Boston Philadelphia Pittsburgh Chicago San Francisco London, England

TRACY STEAM PURIFIER

—in place of the so-called "Dry Pipe" insures Steam *free* from mineral matter and *100%* dry by calorimeter test regardless of the load, feed water, or type of boiler.

THE TRACY ENGINEERING CO., San Francisco, Calif.

Here's Another Big Advantage of



SONDERGLASS

"The Unbreakable Boiler Gauge Glass"
Doesn't "Milk Over"

AS a result, you'll have better feed regulation, and a saving in coal. And fuel saving deserves more than passing notice NOW.

Because of the uncommon strength of SONDERGLASS, it outlasts ordinary makes. It withstands sudden drafts, or splashes of cold water. It MAY EVEN SAVE YOUR EYE-SIGHT, as there is no danger from flying glass.

SONDERGLASS is made of two semi-metallic substances, having different degrees of expansion, made into one clear pressure-resisting tube.

Order a dozen from your dealer or direct

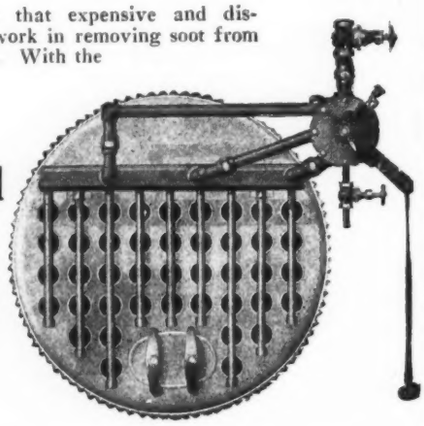
A. W. Chesterton Company

64 India Street, Boston, Mass.

The Cleaner That Brings Joy to the Engineer

Because it ends that expensive and disagreeable hand work in removing soot from your boiler tubes. With the

National Flue Cleaner



installed, flue cleaning dread and expense become a by-gone. A period of joy begins.

An installation of piping on the boiler front with a patented jet before each tube. The piping is divided into sections, into each of which dry steam is admitted at the will of operator.

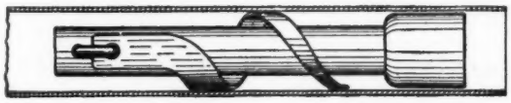
When steam enters a section it is expelled with force through all jets of the section, and in a few seconds removes all soot and ash. The system is indestructible—maintenance nothing. Results guaranteed.

In order that we may quote you a price intelligently—please tell us the number of tubes in each of your return tubular boilers, and whether uptake is front or rear.

Ask for further particulars.

National Flue Cleaner Company, Inc.
Groveville, N. J.

GRIFFIN CONDENSER TUBE CLEANER



How WELL—how OFTEN are you cleaning your condensers? Not as WELL, not as OFTEN as you would like to because you have not adopted the proper methods.

This cleaner is forced thru the tubes with water pressure. IT cleans EFFECTIVELY and RAPIDLY.

Write for Illustrated Pamphlet

C. M. GRIFFIN CO.
211 S. Neville St., Pittsburgh, Pa.

RUGGLES "PERFECTION" FLUE CLEANER

THE RUGGLES Perfection Flue Cleaner is absolutely dependable. Its successful record of SIXTEEN YEARS supports that assertion. *Write for details.*

SEE YOUR DEALER TODAY

RUGGLES AND RUGGLES
Batavia, Illinois

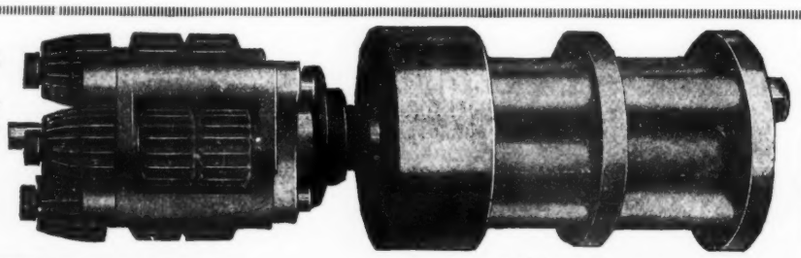
ALL SIZES SHIPPED FROM STOCK

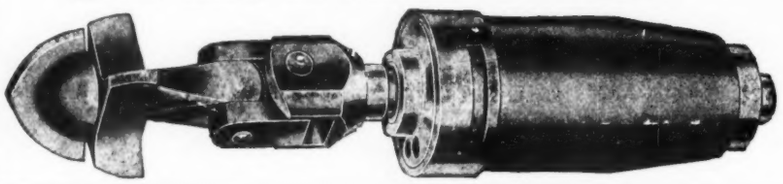
Remove All The Scale

from Boilers, Condensers, Evaporators, Economizers, etc., in the quickest and safest way by using

ROTO TUBE CLEANERS

Type A. D.—Driven by Air or Steam
Type W. D.—Driven by Water Pressure





The dependability and economy of Roto Tube Cleaners has made them the standard equipment in the largest steam power plants.

THE ROTO COMPANY
HARTFORD, CONN.
WRITE FOR CATALOG

SESCO

For clean boiler tubes

AN effective, special treatment, based on the chemical analysis of your feed water. If applied according to directions, it will loosen old scale and prevent the formation of new scale. It is not a "cure-all."

Send sample of water for free analysis

Sterling Equipment & Supply Co., American and Buttonwood Sts., Philadelphia, Pa.

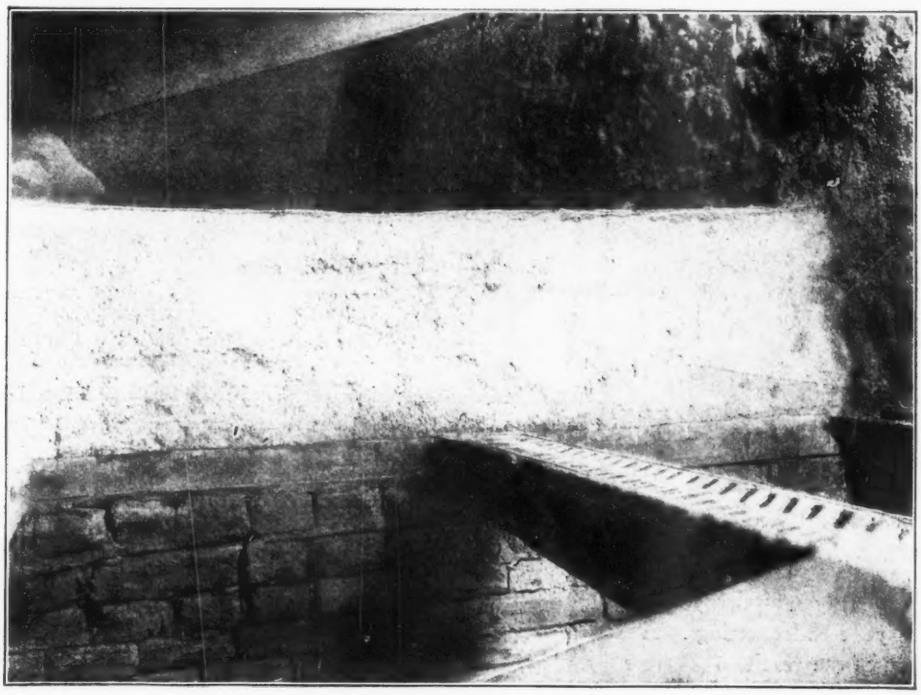
Clean Tubes—Mean Lower Coal Bills

You cannot obtain maximum heat transmission in your boilers if the tubes are coated with soot. Keep them clean and save coal by using the

Tornado Boiler Tube Cleaner

Blows out every grain of soot by dry air, using just enough steam to get a continuous strong blast. This cleaner is more efficient than the use of a scraper and brush. It is light and easily handled—sent on trial.

THE PAUL B. HUYETTE CO., Inc.
5 So. 18th Street, Suite 25 PHILADELPHIA, PA.



Completed bridge wall lined with 4½ inches of PLIBRICO Jointless Fire Brick, forming a solid one piece covering

PLIBRICO
JOINTLESS
FURNACE LINING

A high grade, plastic refractory capable of being molded and baked in place for linings, bridge walls, and door arches.

Smooth surface, jointless, and air and gas tight settings are easily built up with Plibrico.

Plibrico will stand 3100 deg. F., can be installed by inexperienced labor, and will outlast fire brick in boiler furnace or oven. It is unequalled for patching.

And when it comes to baffles—horizontal and vertical, any type of boiler —let us supervise your first installation and you will put in your own baffles without any further help ever after.

Old boiler settings are reborn by patching with Plibrico.

Shipped in steel containers. Warehouse stock carried in all principal cities for immediate delivery.

TRADE MARK

Jointless Fire Brick Co.
Manufacturers of Plibrico
1135-1150 Clay St., Chicago, Ill.

EVERTITE

Can be applied with a trowel

A 1/8-in. coating with an ordinary trowel, by any workman, will stop leaks in your boiler settings. A 3 to 10% **coal saving** will be the result.

Ask about our Trial Offer

The Excello Mfg. Company
Main Office: Union Building, Cleveland, O.
Warehouses in All Principal Cities
The R. C. Miller Oil & Supply Co., 38-40 Youville Sq. Montreal, Que., Can.

To the Man Who Owns Furnaces

BONDITE

is more than the name of a product. It means Service, Science and Cement as applied to furnace construction.

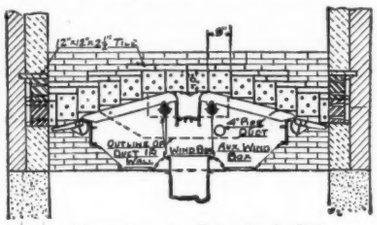
Write for booklet

Pitts & Kitts Mfg. & Supply Co.
52 Park Place, New York

Non-Clinkering Furnace Blocks

Prevent Clinker Adhesion to Walls

THIS construction is different from any heretofore produced and is of record in the U. S. Patent Office.



Write for Information. Branches in Principal Cities
Patents Pending

Drake Non-Clinkering Furnace Block Co., Inc.
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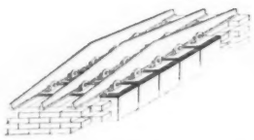
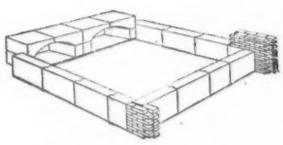
DEAN FIRE BRICK SPECIALTIES



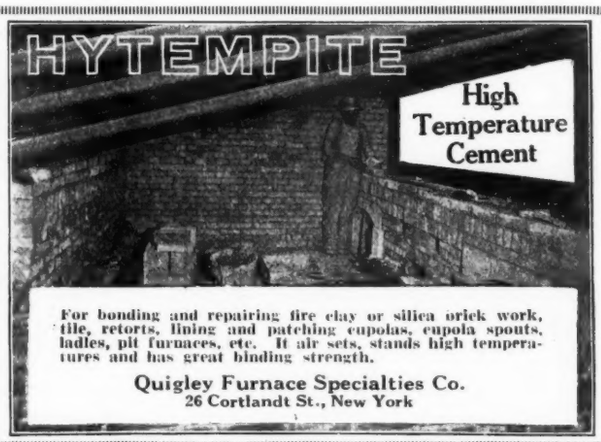
Dean Flat Suspended Arches



Dean Door Arches and Furnace Blocks

Send for details

WASHBURN & GRANGER, Inc.
50 Church St., New York, N. Y.



For bonding and repairing fire clay or silica brick work, tile, retorts, lining and patching cupolas, cupola spouts, ladles, pit furnaces, etc. It air sets, stands high temperatures and has great binding strength.

Quigley Furnace Specialties Co.
26 Cortlandt St., New York

WIEDERHOLDT SYSTEM CHIMNEYS

Correct in Design **Supreme in Strength** **Lowest Upkeep**

Write your own guarantee. We will stand behind it.

WIEDERHOLDT CONSTRUCTION CO., Bank of Commerce, St. Louis, Mo.

"TAYCO"—*A Scientific*—FIRE BRICK

A new refractory for high and sudden changes in temperature. Makers also of fire clay brick, baffle tile, fire door arches and jambs, etc.

(See ½ page ad first week each month)

The Chas. Taylor Sons Co.
General Offices—Cincinnati.

DAILY CAPACITY 150,000

A. P. Green Fire Brick

MEXICO, MISSOURI

WALSH FIRE BRICK

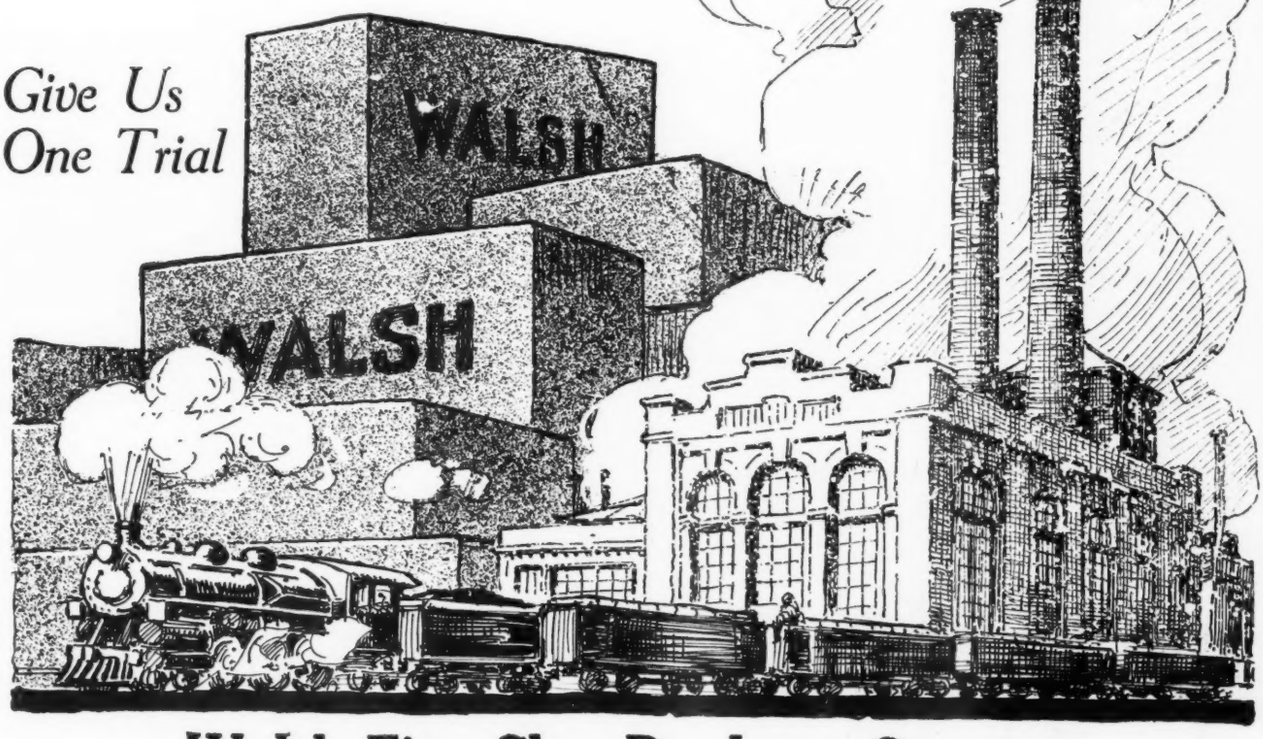
Behind Steady Production

The use of Walsh Brands of Fire Brick increase the life of the furnaces and shorten the periods between shutdowns for repairs. Thus they aid operators, in all industries in all parts of the country, to meet demands for increased and continuous steam production—resulting in steady plant production.

Walsh Fire Brick are unaffected by high heat or sudden temperature change. Because of their high refractory property they resist fusion successfully, and are subject to the minimum of shrinkage. The dense close structure prevents rapid wear by abrasion.

Tested by 30 years' use in the high temperatures of tin smelters they are bound to make good in your underfeed stoker-fired boilers. Write to our nearest office for further particulars.

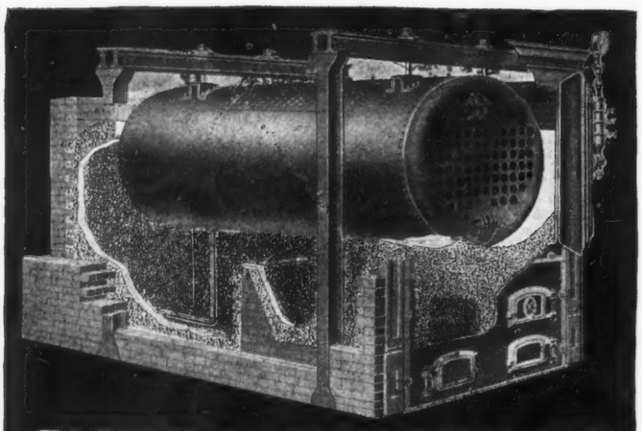
Give Us One Trial



Walsh Fire Clay Products Company

4071 N. Main Street, St. Louis, Mo.

CHICAGO OFFICE: 7 W. Madison St. **NEW YORK OFFICE: 220 Fifth Ave.**



SMILES AT HIGH HEAT

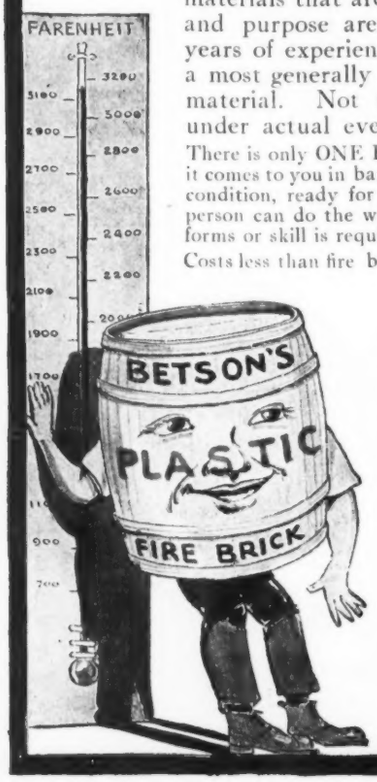
Boiler furnace linings moulded into place forming a solid, one-piece monolithic lining, will withstand the variations and extremes of heat under continuous service, when the proper lining material is used, viz:

BETSON'S
REG. U.S. TRADE MARK PAT. OFF.
PLASTIC FIRE BRICK

The result of twenty years of scientific and practical experience. Only those refractory materials that are of tested quality and purpose are used, and these years of experience have produced a most generally satisfactory lining material. Not theoretically, but under actual everyday conditions.

There is only ONE Plastic Fire Brick and it comes to you in barrels in a moist plastic condition, ready for use. Any intelligent person can do the work, no special tools, forms or skill is required.

Costs less than fire brick or special blocks, is always available and will outlast other linings.



Write for our informing pamphlet—it is worth having in your file, whether you need lining material now or not.

Order in advance of your need on account of slow freight delivery.

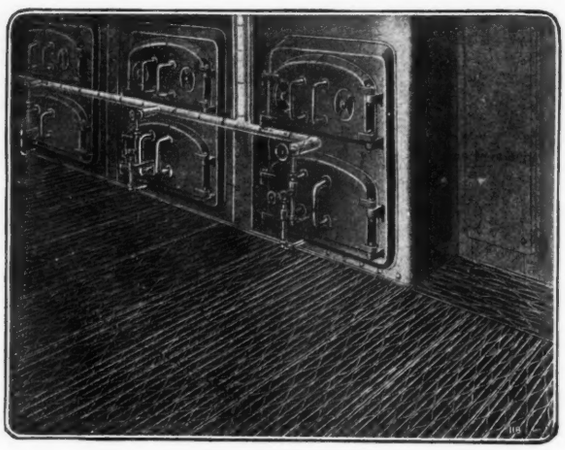
Betson Plastic Fire Brick Co., Inc.
P. O. Box 386-4
ROME, N. Y.

New York Office, 50-4 Church St.
Chicago Office, 1514-4 Kimball Bldg.

Shipment F.O.B. nearest warehouse, in our new, substantial "Yellow-Top" barrel.

IRVING SUBWAY TRADE MARK (PATENTED) THE FIREPROOF VENTILATING FLOORING

IRVING SUBWAY
TRADE MARK
(PATENTED) REG. U.S. PAT. OFF.
THE FIREPROOF VENTILATING FLOORING



A floor of Irving Subway in an oil-fired boiler room

The Lightest, Strongest, Most Durable Grating

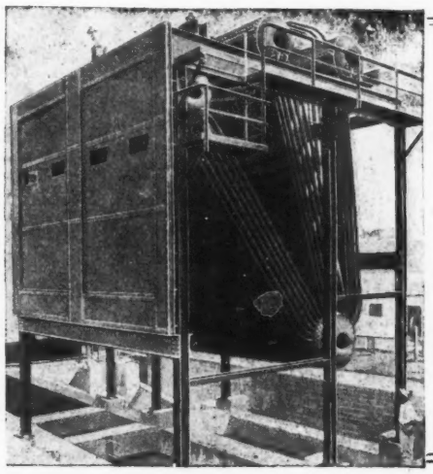
That this is a fact and not a mere claim is proved by both laboratory and service tests of **Irving Subway,** under all conditions and over long periods. Weight for weight and span for span, it has a greater load capacity than any other grating—because its truss construction distributes the load over the whole panel area. And because **Irving Subway** is made in quantities—manufactured, not built—you get all this big value at a price lower, per unit area, than that of any other grating. Ask for Catalog 2A14.

IRVING IRON WORKS CO.
LONG ISLAND CITY. N.Y., U.S.A.

Workers in Iron and Steel to Quality Standards, and

Manufacturers of

TRADE MARK
IRVING SAFSTEP
(PATENTED)
ABSOLUTELY NON-SLIPPING ALWAYS



This picture shows a 1058 H.P. unit at Andrews Steel Co., Newport, Ky.

Connelly Water Tube Boilers

(Patented)

are of the 4-drum type, have 100 per cent. tube area in the path of the circulation, and deliver steam slightly superheated. Simple in design, have no flat surfaces, no stay-bolts, and free from hundreds of joints (no handholes). Easily accessible for cleaning internally and externally. Can be built in units up to about 4000 hp.

Write for copy of our new Catalog. (Desk 4)

The D. Connelly Boiler Co., Cleveland, Ohio

Founded in 1875 by Daniel Connelly

The Babcock & Wilcox Company

85 Liberty Street, New York

WATER TUBE STEAM BOILERS

Steam Superheaters—Mechanical Stokers

Barberton, Ohio—WORKS—Bayonne, N. J.

BRANCH OFFICES:

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PHILADELPHIA, North American Bldg.
SAN FRANCISCO, Sheldon Bldg.
PITTSBURGH, Farmers Deposit Bank Bldg.
NEW ORLEANS, 533 Baronne Street.
DENVER, 435 Seventeenth Street.
SALT LAKE CITY, 705-6 Kearns Bldg.
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ATLANTA, GA., Candler Bldg.
CLEVELAND, Guardian Bldg.
SEATTLE, Mutual Life Bldg.
HAVANA, CUBA, Calle de Aguiar 104.
LOS ANGELES, I. N. Van Nuys Bldg.
CINCINNATI, O., Traction Bldg.
HOUSTON, TEXAS, Southern Pacific Bldg.
SAN JUAN, PORTO RICO, Royal Bank Bldg.

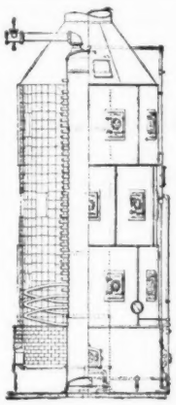
AMPLE furnace volume is afforded for the combustion of low-grade bituminous coal in

MORRIN-CLIMAX Vertical Tube Boilers

as the settings are unusually high above the fire chamber.

Write for more details.

Morrin-Climax Boiler Co.
Jersey City, N. J.



THE EDGE MOOR WATER TUBE BOILER

Especially Suitable for Large Power Plants

Steel construction throughout. Straight tubes. All hand-holes elliptical, their covers internal and removable through their own openings. Unrestricted circulation permitting forcing of fires with safety and economy.

Send for Bulletins on Performance

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BOSTON — EDGE MOOR, DELAWARE — NEW YORK — CHICAGO

"Sectional Water Tube Boiler Specialists for Over Fifty Years"

ROOT WATER TUBE BOILERS
SPIRAL RIVETED PIPE

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SPRINGFIELD BOILERS

WATER TUBE BOILERS
SECTIONAL
ALL STEEL

Springfield Boiler Co.
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HEINE

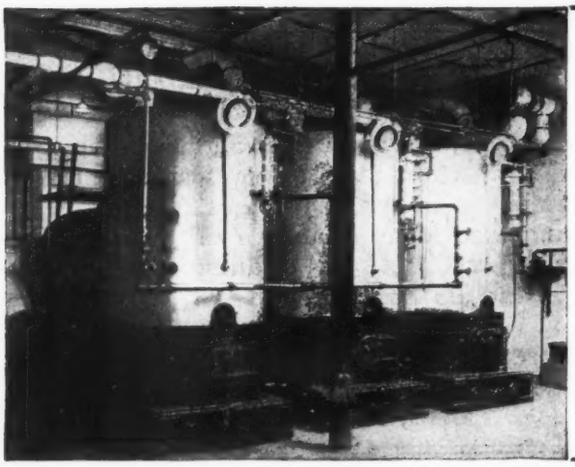
Water-Tube

BOILERS

HELIOS

We also manufacture Heine Superheaters, Steel Stacks and Boiler Casings. Our book, "Boiler Logic," tells all about Heine Boilers. "Superheater Logic" describes and shows the Heine Superheater.

Heine Safety Boiler Co.
5315 Marcus Ave., St. Louis, Mo.



IMMEDIATE DELIVERY

High Pressure, Heavy Duty

Fitzgibbons Boilers built for 125 lbs. working steam pressure in accordance with A. S. M. E. Code in stock ready for immediate shipment.

Catalog and quotations upon request

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Established 1886

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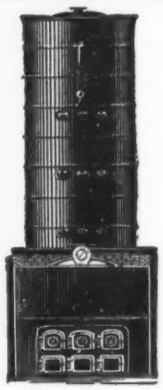
Boston: M. B. Spooner, 141 Milk St.



Steel Cased Setting Increases Efficiency.

Wickes Vertical Water Tube Boiler

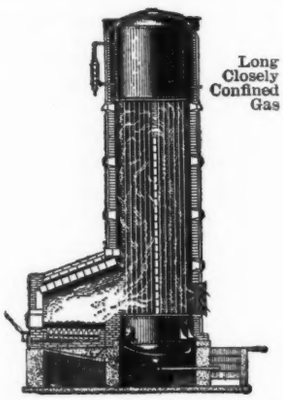
Have you seen the STEEL CASED SETTING for enclosing this boiler?
Air infiltration losses are overcome.
The highest possible thermal efficiency results.

Ask for bulletin—Magnitude and Prevention of Air Infiltration Losses—sent free

THE WICKES BOILER CO., SAGINAW, MICH.

SALES OFFICES:

New York City, 1716 West St. Bldg.
Chicago, 76 West Monroe St.
Pittsburgh, 1218 Empire Bldg.
Boston, 201 Devonshire St.
Detroit, 1116 Penobscot Bldg.
Seattle, 736 Henry Bldg.



Long Closely Confined Gas

PARKER
Downflow Boilers

Deliver dry steam at the maximum safety and economy. High in overload capacity. The rapid downward circulation reduces scaling and makes fewer tube renewals necessary. To save coal and repairs—specify Parker Boilers. Write

Pardel Corporation
Bailey Building
PHILADELPHIA, PA.

WATER TUBE BOILERS
UNION IRON WORKS
ERIE, PENN.

See Full Page Advertisement in last week's issue.

HIGH PRESSURE BOILERS

Horizontal Return Tubular Boilers
Vertical Manning Type Boilers
Water Tube Boilers
Brady Scotch Boilers
Smith Door Protectors
Special Plate Work
Macdonald Shaking Grates.

Send for Bulletins now.

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BADENHAUSEN
Water Tube Boilers and Superheaters

High Constant Efficiency and Unlimited Overload Capacity

Ask for Catalogue

***BADENHAUSEN CO.*, Philadelphia, Pa.**

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Coatesville Boiler Works

Manufacturers of
Steel Tanks, Boilers and Special Steel Plate Construction

WORKS: Coatesville, Pa.
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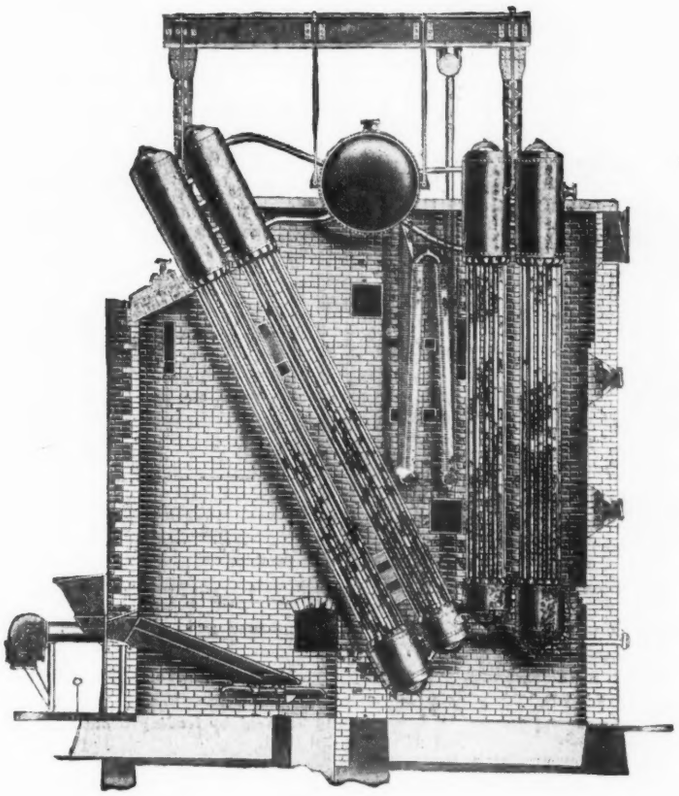
RUST CHIMNEYS

RADIAL BRICK AND REINFORCED CONCRETE
REFRACTORY BRICKWORK

The RUST ENGINEERING CO.
ENGINEERS AND CONTRACTORS
PITTSBURGH WASHINGTON BIRMINGHAM

Vogt BOILERS
WATER TUBE
RETURN TUBULAR
HENRY VOGT MACHINE CO., Louisville, Ky.

Less Tendency to Scale



Bigelow-Hornsby Water Tube Boilers

operate continuously for long periods with little or practically no scale formation in the lower tubes that are exposed to the radiant heat of the fire. This advantage is due to the exceptionally rapid circulation and the preheating of the feed water in the rear vertical tubes by the cooler gases. This causes most of the scale to be precipitated in the mud drum from which it may easily be blown or removed through the manhole.

These boilers are particularly adapted to high over-ratings. Built in units from 380 to 3000 hp. and upward.

Write for new catalog B-H-20

Also manufacturers of H. R. T. and Bigelow-Manning Boilers

The Bigelow Company, 72 River St., New Haven, Conn.

Established 1860

Boston Office, 1001 Oliver Bldg. Philadelphia Office, 515 Commercial Trust Bldg. New York Office, 928 Singer Bldg.

Stop the Engine Quick!

You can do it instantly from any number of chosen points in your plant by the absolutely dependable remote control afforded with

Falls Engine Stops

This feature combined with their primary purpose to instantaneously shut off the steam when the engine speed exceeds the safe limit makes them indispensible for the protection of your entire plant.

Gravity actuated. The valves close without side or stem friction.

Approved by leading Casualty Companies.

Write us for full details now.

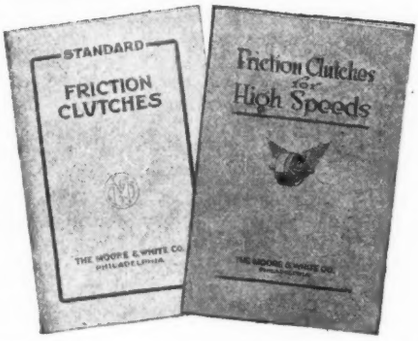
JENKINS MACHINE CO.
Sheboygan, Wis.

Figure Your Friction Clutch Installations With These Books

Sent free upon request. Write today for copies.

Contain Complete Information Regarding Friction Clutches for All Kinds of work.

Weights, Bores, Dimensions, Speeds, Horsepowers, etc.

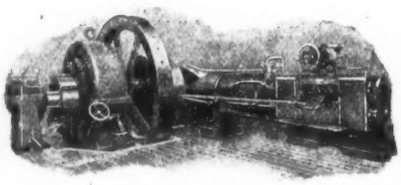


We make Standard Clutches for low speeds and moderate horsepower. High Speed Clutches for high speed and great horsepower. If you have any use at all for Friction Clutches, send for Catalogs "P." "M & W" Friction Clutches eliminate transmission troubles.

Made only by

THE MOORE & WHITE CO.
2703-2733 North 15th Street, Philadelphia, Pa., U. S. A.
Established 1886
Sold by leading dealers in Mine, Mill and Factory Supplies

Since 1870



The Fitchburg Engine

has maintained its lead in overall economy in daily practice.

Fitted with patented, perfectly balanced, double ported expansible piston valves, operated to give very quick opening and closing by a Corliss wrist actior

Unsurpassed in speed regulation. Ideal for driving alternates or d.c. generators in parallel.

Built in all styles. Vertical, horizontal and high-speed. Tandem, cross-compound or triple expansion. Direct connected, belted or rope drive.

The Fitchburg Steam Engine Co.
Fitchburg, Mass.
Agencies in all sections of the country

IT IS OUR job to get broken down engines back in the running in short order.

The UNDERWOOD Repair Crew

are ready to obey your call day or night. If you want us quick—don't delay. We're always ready.

H. B. Underwood Corporation
Established 1870
1019 Hamilton St., Philadelphia, Pa.

WESTERN DIESEL ENGINES

Meet the most rigid demands for economy, speed regulation and continuous service. Sizes 25 to 150 B.H.P. Write for Bulletin No. 502.

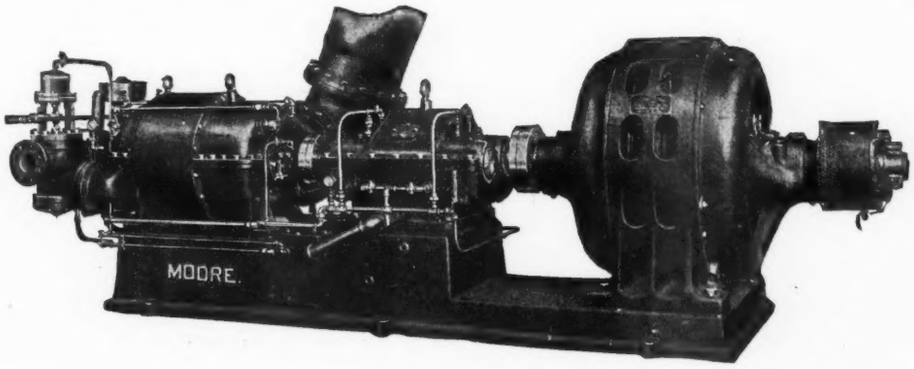
WESTERN MACHINERY COMPANY
902 North Main St., Los Angeles, Cal.
Branch Office: Rialto Bldg., San Francisco

Get our catalog today

It shows you why your valves should have Babbitts attached.

Babbitt Steam Specialty Co. New Bedford, Mass.

Babbitt *Adjustable* **SPROCKET RIM** *with Chain Guide*



MOORE STEAM TURBINES

Single and Multi-Stage

Let Them Drive Your Generators

No more dependable or more economical drive could be selected in capacities up to 500-kw. ratings. The smooth operation, close speed regulation, high steam economy, and absence of rapid, wear place them in the first rank for power generation. Their application to centrifugal pumps, fans, blowers, stoker shaft and special drives in leading power and industrial plants have demonstrated their excellence conclusively under all service conditions.

The operating speed of the single stage type does not exceed 5,000 r.p.m. and that of the multi-stage type does not go beyond 3,600 r.p.m. When necessary Moore Double Helical Reduction Gears are recommended for slow speed drives.

Write us for full particulars. Interesting Bulletin on request.

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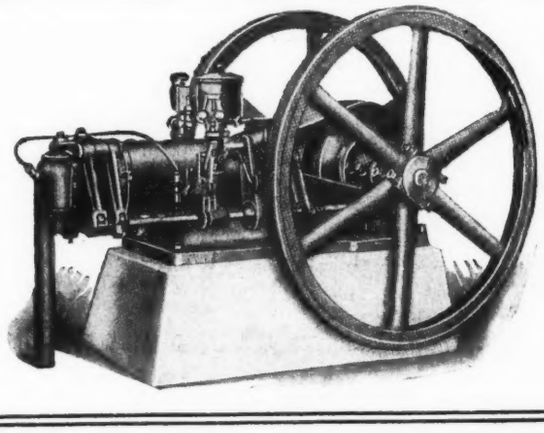
Chicago—455 People's Gas Bldg.
Cleveland—511 Citizens Bldg.
St. Paul, Minn.
New Orleans—636 So. Peters St.
Birmingham—Brown-Marx Bldg.



Economy—endurance and reliability are advantages of

THE McEWEN Low Compression Oil Engine

that have a strong appeal to power users. Another big point is the fact, that fuel oil, crude oil, kerosene, gas oil, naptha and benzol may be used for fuel—*at a cost approximately five cents per horse-power* for an entire day.

Write for particulars.

McEwen Bros., Wellsville, N. Y.

STATIONARY
120 TO 3300 B.H.P.

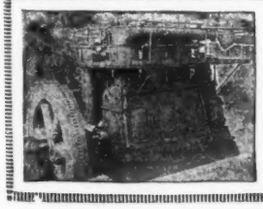
MARINE
600 TO 3000 SHAFT H.P.

BUSCH-SULZER DIESEL

AMERICAN DESIGNERS AND BUILDERS OF DIESEL ENGINES SINCE 1898

BUSCH-SULZER BROS.-DIESEL ENGINE CO., ST. LOUIS, U.S.A.

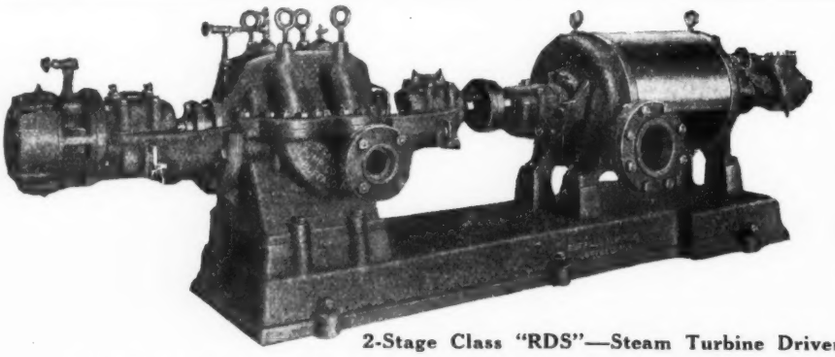
NEW YORK, NO. 60 BROADWAY
SAN FRANCISCO, RIALTO BLDG.



McINTOSH & SEYMOUR CORPORATION

DIESEL TYPE OIL ENGINES

AUBURN, N.Y.
New York Office, 149 Broadway



2-Stage Class "RDS"—Steam Turbine Driven

No Balancing Device, with Reduced Pump Efficiency Is Necessary

BUFFALO DOUBLE SUCTION IMPELLER MULTISTAGE CENTRIFUGAL PUMPS are designed so that water enters each side of each impeller in equal volume and pressure. This puts all rotating parts in hydraulic balance at all times, and a balancing chamber with its leakage and consequent loss in pump efficiency is not required. A Marine type thrust bearing keeps impellers in correct position when starting up, and takes up thrust if one impeller gets clogged with foreign matter.

This pump has very flat horse power characteristics and maintains high efficiencies over a wide range of capacities.

Can be furnished in two, three and four stages.

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BUFFALO STEAM PUMP COMPANY

Buffalo, N. Y.

Manufacturers of Steam, Power and Centrifugal Pumps, and Condensers.

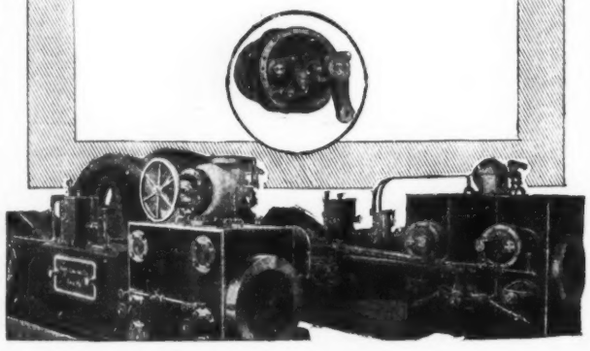
New York	Pittsburgh	Chicago	New Orleans	Denver
Boston	Cleveland	St. Louis	Atlanta	Salt Lake City
Philadelphia	Detroit	Los Angeles	Minneapolis	

BALL ENGINES

have saved their owners thousands of dollars every year by reliable operation, low steam economy and low maintenance cost.

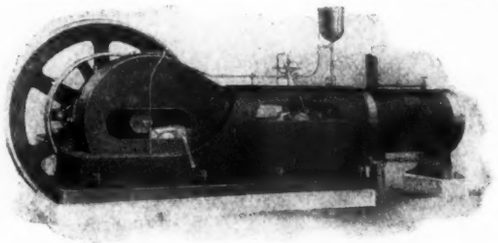
They can do this for you.

Ball Engine Company
Erie, Pa.



BUCKEYE ENGINES

Steam Engines, Simple and Compound, High, Low and Medium Speed



Gas Engines, Two and Four Cylinder, Double Acting Tandem Type.

Buckeye Engine Co., Salem, Ohio

The C. & G. Cooper Co.
Mount Vernon, Ohio
Write for descriptive catalogues.

ENGINE BUILDERS

CORLISS ENGINES—50 to 10,000 H.P.
GAS ENGINES—200 to 3000 H.P.

PRIMM HEAVY DUTY OIL ENGINES

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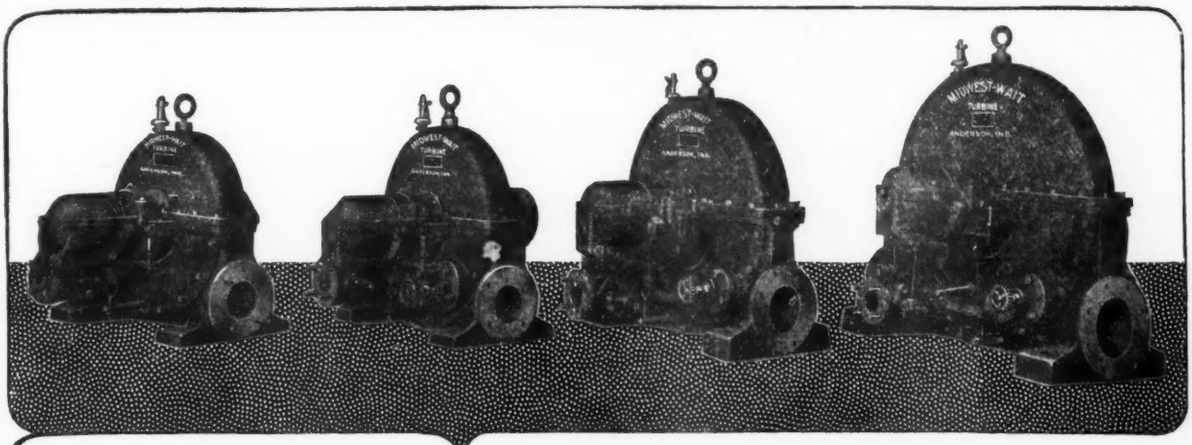
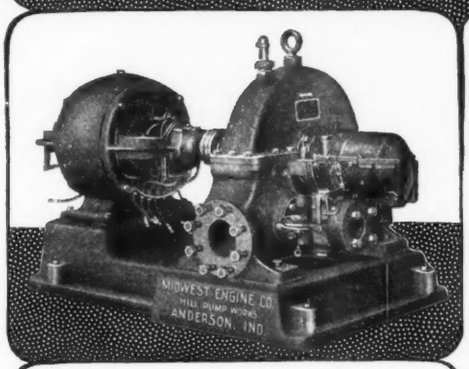
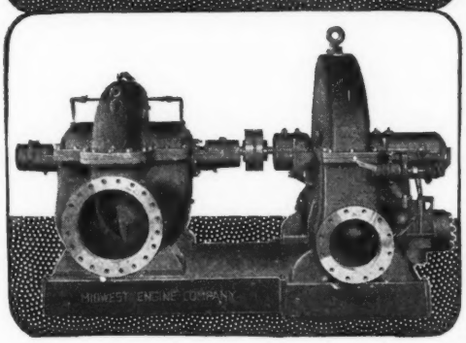
Power Manufacturing Company
927 Cheney Ave., Marion, Ohio







MIDWEST

In the Representative Plants of Every Industry

Midwest-Wait Steam Turbines are used in numbers by the foremost concerns in every line—

Swift and Company	Kingan and Company
Armour and Company	Midland Packing Company
Morris and Company	Emerson-Brantingham Co.
Cleveland Electric Ill. Co.	Morton Salt Company
U. S. Coal and Coke Company	Toledo Ry. Lt. and Power Co.
Sloss-Sheffield Steel Co.	Otis Steel Company
Puget Sound Traction & Lt. Company	Michigan Power Company
	New Orleans Refining Co.
Minnesota Sugar Company	U. S. Commissioner of Indian Affairs
Shell Co. of California	
Roxanna Petroleum Co.	San Antonio Public Serv. Co.

And a HOST of others

Some of these companies use as many as SEVENTY Midwest-Wait Steam Turbines purchased over a period of several years.

The most reliable and economical form of Power. Flexible and as easily handled as an electric motor.

Midwest-Wait Steam Turbines are unusually efficient, the steam consumption per B. H. P. hour is remarkably low.

Used in every class of service where economy of fuel, high efficiencies and space are factors.

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DEPENDABLE POWER

Midwest Engine Company Products

Midwest—Centrifugal, Reciprocating and Deep Well Pumps and Auxiliaries
Midwest—Utilitor
Midwest—Truck Engines
Midwest—Tractor Engines
Midwest—Wait Turbines (Impulse Type)

Address—Midwest Engine Co., in the following cities:

Birmingham	Jacksonville	Philadelphia
Baltimore	Kansas City	Pittsburg
Boston	Los Angeles	San Francisco
Cleveland	Little Rock	Salt LakeCity
Chicago	Medicine Hat, Alta.	St. Louis
Denver	Montreal, Quebec	St. Paul
El Paso	New York City	Seattle
Houston	New Orleans	Tulsa

MIDWEST ENGINE COMPANY
Main Office and Works
INDIANAPOLIS, U. S. A.

Dependable Power

Substitutes rarely deliver anything but excuses. A good packing doesn't explain or apologize—it delivers the goods every time. Skookum is a good packing—the original Diagonal Cross Expansion Piston Rod Packing

Moral:
Beware of *Substitutes*
—they're *April Foolers!*

There's a distributor in your vicinity.
If not, write us! Test sample on request.
Skookum is sold in Canada as Spando.

PIONEER RUBBER MILLS
[Formerly Bowers Rubber Works]
General Offices: San Francisco
Sales Offices: Los Angeles, Denver, Salt Lake City
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HI

Why Ohio Grease?

Because

it gives better and more economical lubrication than oil—

we supply testing material FREE to prove it—

we furnish GRATIS all necessary instruments to feed it—

we instruct you how to get the best and most resultful service.

Write for further details of OHIO co-operation

The Ohio Grease Co.

Box 816
Loudonville, Ohio

NON-FLUID OIL

Which?
1 pound of

TRADE MARK REGISTERED IN
NON-FLUID OIL
UNITED STATES PATENT OFFICE

or 3 pounds of Grease?

NON-FLUID OIL is a purer lubricant and has gr a.er lubricating value than grease—it keeps bearings cooler.

NON-FLUID OIL won't melt with heat, as grease does, and waste out of bearings—it lasts longer than grease.

Better lubrication at less cost per month—that's NON-FLUID OIL.

Write today for free testing samples, today; don't put it off; I will show you how to lessen labor and trouble.

NEW YORK & NEW JERSEY
LUBRICANT COMPANY
401 Broadway, New York

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IN STOCK

For Immediate Shipment

Elevator
Brine
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Compressed Air
Filter
Fuel Oil
Hot Water Storage
Hydro-Pneumatic
Pressure

TANKS

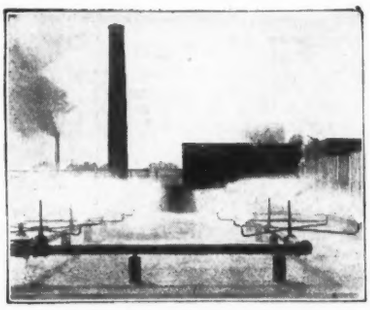
Stacks - Breechings - Stand Pipes
BUILT AND ERECTED
Riveted Pipe

Lancaster Iron Works, Inc.
Breneman Bldg., Lancaster, Pa.

Horizontal Storage Tanks (Flat Heads)

Diameter	Length Feet	Shell, Inches	Heads, Inches	Capacity, Gallons	Weight Pounds
3 ft. 6 in.	14	3/16	3/16	1,000	2,000
3 ft. 6 in.	14	1/4	1/4	1,000	2,480
4 feet	22	3/16	3/16	2,000	3,285
4	22	1/4	5/16	2,000	4,180
5	20	3/16	3/16	3,000	3,880
5	20	1/4	1/4	3,000	4,875
5	28	3/16	3/16	4,000	5,000
5	28	1/4	1/4	4,000	6,375
6	24	3/16	3/16	5,000	5,390
6	24	1/4	1/4	5,000	6,800
6	29	3/16	3/16	6,000	6,245
6	29	1/4	1/4	6,000	7,955
7	25	3/16	3/16	7,000	6,665
7	25	1/4	1/4	7,000	8,400
7	28	3/16	3/16	8,000	7,250
7	28	1/4	1/4	8,000	9,170
8	24	1/4	5/16	9,000	9,270
8	24	5/16	5/16	9,000	10,575
8	28	1/4	1/4	10,000	10,500
8	28	5/16	5/16	10,000	12,000
8	30	1/4	1/4	11,000	11,185
8	30	5/16	5/16	11,000	12,820
8	32	1/4	1/4	12,000	11,760
8	32	5/16	5/16	12,000	13,490
8	35	1/4	1/4	13,000	12,630
8	35	5/16	5/16	13,000	14,520
8	37	1/4	1/4	14,000	13,230
8	37	5/16	5/16	14,000	15,020
8	40	1/4	1/4	15,000	14,090
8	40	5/16	5/16	15,000	16,230
10	16	1/4	1/4	9,400	9,200
10	16	5/16	5/16	9,400	10,260
10	24	1/4	1/4	14,100	12,195
10	24	5/16	5/16	14,100	13,780
10	32	1/4	1/4	19,800	15,185
10	32	5/16	5/16	19,800	17,300
10	40	1/4	1/4	23,500	18,860
10	40	5/16	5/16	23,500	21,620

Spray Cooling Sysetms



Wherever water for condensing purposes is scarce or procured only at very high temperature a SPRAY COOLING SYSTEM can solve your problem, increasing condensing efficiency at the lowest expense. It is the most efficient, practical, and reliable method of water cooling.

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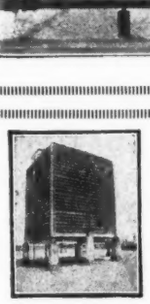
The Star Brass Works
Manufacturing Engrs.
3114 Carroll Avenue
Chicago, Ill.

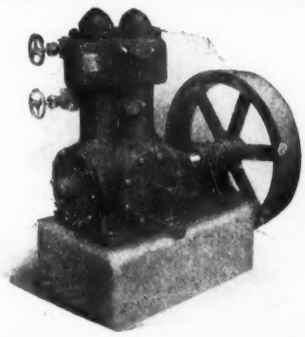


Burhorn's
"Packer's Type"
Cooling Towers

Particularly adapted to continuously re-cool ammonia condenser water. Minimum operating and upkeep cost. Write for "Packer's Type" Booklet.

Edwin Burhorn Co.
25 West Broadway New York City

SPRACO PRODUCTS
COOLING PONDS
AIR WASHERS
SPRAY NOZZLES
FLOW METERS
PAINT GUNS
SPRAY ENGINEERING CO. BOSTON, MASS.



YORK ENCLOSED REFRIGERATING MACHINES

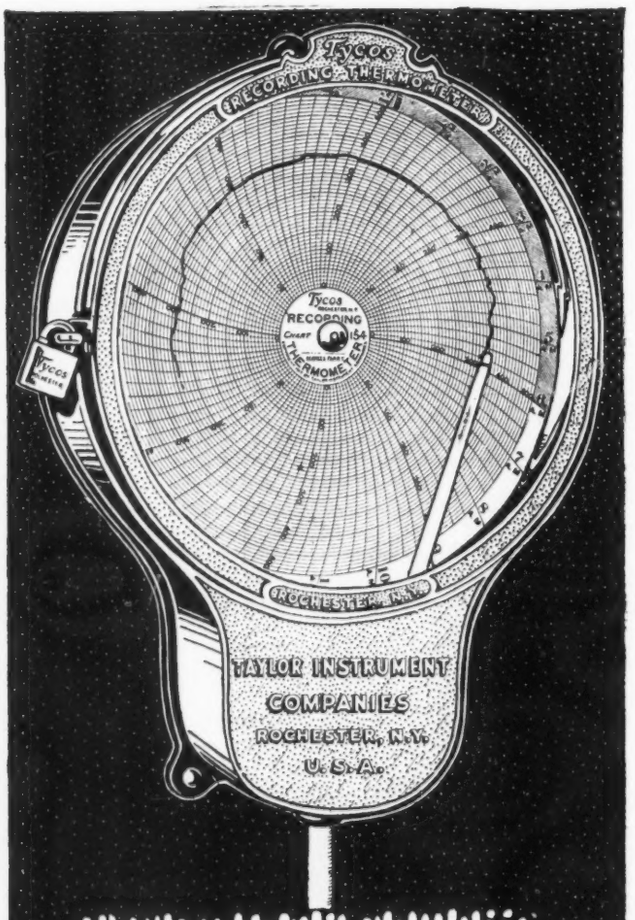
Simplicity—Economy

After operating one of our Enclosed Machines for several years, one of our customers writes us that he has not spent one cent on it except for oil, and is still using the original charge of ammonia.

This is a common experience among users of these Machines, and besides MECHANICAL REFRIGERATION pays good dividends on the investment.

Write us for information and prices.

YORK MANUFACTURING CO.
(Ice Making and Refrigerating Machinery Exclusively)
York, Pa.



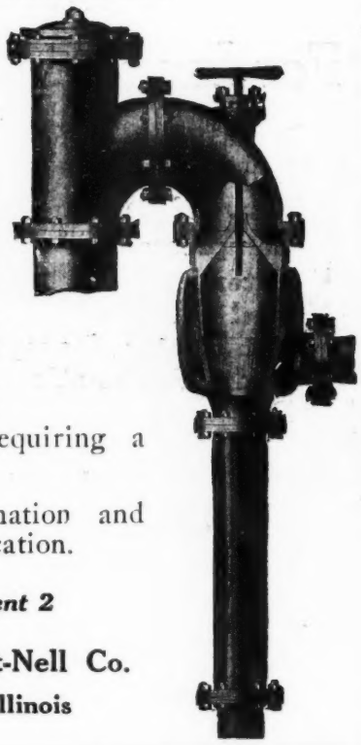
There's a *Tycos* or *Taylor* temperature instrument for every purpose

Taylor Instrument Companies
ROCHESTER, NEW YORK

AA

The Baragwanath Barometric Condenser

SAVES FUEL
INCREASES HORSE POWER

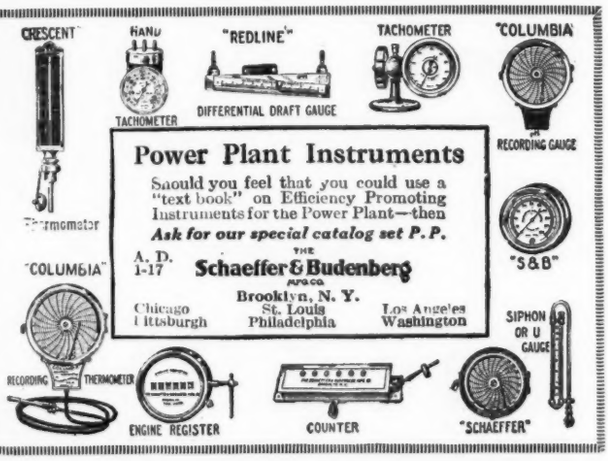


The most reliable, simplest, most economical, least expensive of all forms of condensers. Applicable to any purpose requiring a vacuum.

Further information and prices on application.

Department 2

The Allbright-Nell Co.
Chicago, Illinois



Power Plant Instruments

Should you feel that you could use a "text book" on Efficiency Promoting Instruments for the Power Plant—then

Ask for our special catalog set P. P.

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THE Schaeffer & Budenberg MFG. CO.

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RECORDING EHLING INSTRUMENTS

EQUIP YOUR PLANT WITH UEHLING CO_2 RECORDERS

Keep tabs on the fuel wasted.
Reduce your annual coal consumption.

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Combustion Economists
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MONO SYSTEMS

Carbon Dioxide—CO_2
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Highly developed and efficient instruments for every combustion problem. The Mono will do what others can't—record CO and CO_2 simultaneously.

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MONO CORPORATION OF AMERICA
AUTOMATIC MONO RECORDERS
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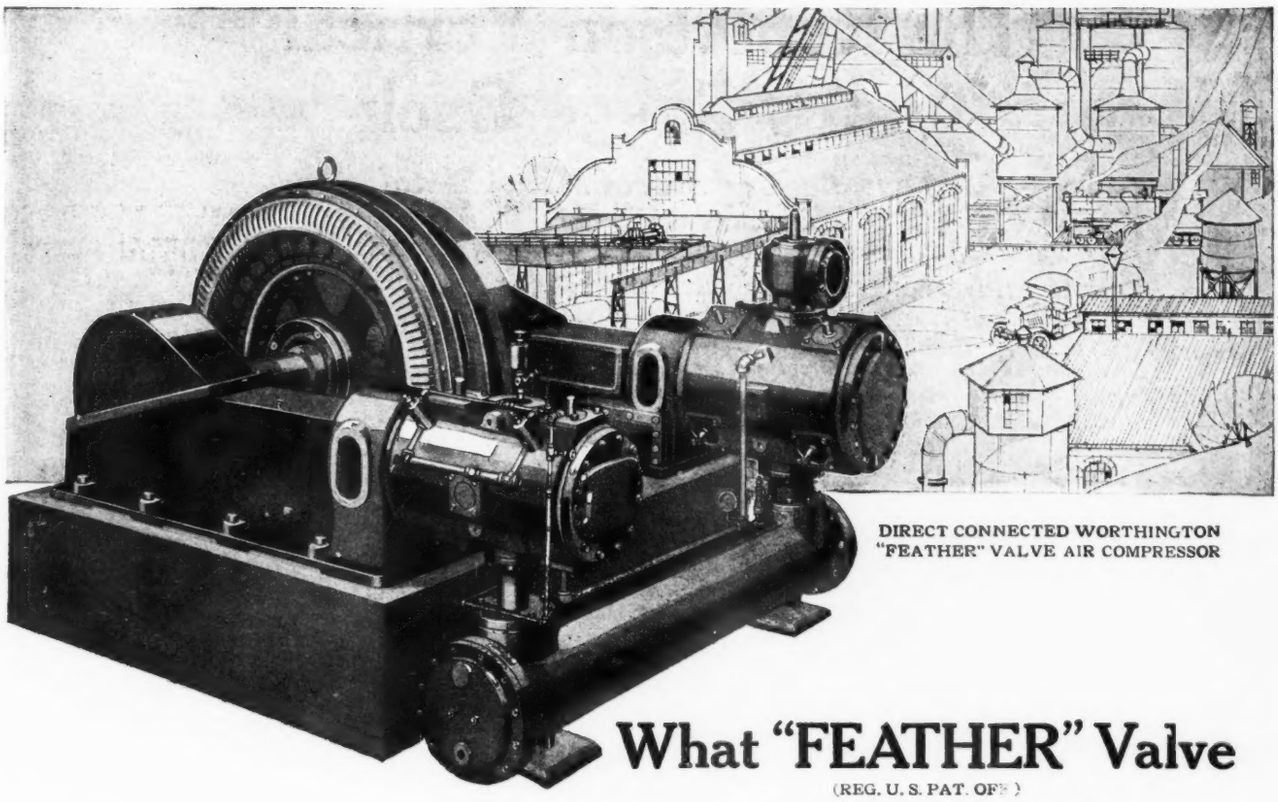

DIRECT CONNECTED WORTHINGTON
"FEATHER" VALVE AIR COMPRESSOR

What "FEATHER" Valve

(REG. U. S. PAT. OFF.)

means to you

"FEATHER" Valve means first: COMPRESSION It means compression that is sure, safe and always on tap. It means also, Worthington apparatus—the sort that is standard the world over, on land or sea.

Worthington "FEATHER" Valve is a thin, ribbon strip of steel, weighs less than one ounce, and has but one moving part—itself. It seats tightly on ground face slotted seats and allows air or gas to pass by bowing in center against slotted curved guards. And it functions without friction or hammering action.

Worthington "FEATHER" Valve compressors are worthy workmates with the widely known Worthington pumps and pumping machinery—world's standard since 1840.

Other Worthington Products:
Steam, Power, Centrifugal and Water Works Pumps. Meters, Oil Engines, Condensing Machinery, Air Compressors, Vacuum Pumps and Water Wheels.

WORTHINGTON PUMP AND MACHINERY CORPORATION
Executive Offices: 115 Broadway, New York City
Branch Offices in 24 Large Cities

PUMPS—COMPRESSORS—CONDENSERS—OIL & GAS ENGINES—METERS—MINING—ROCK CRUSHING & CEMENT MACHINERY

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Deane Works, *Holyoke, Mass.*
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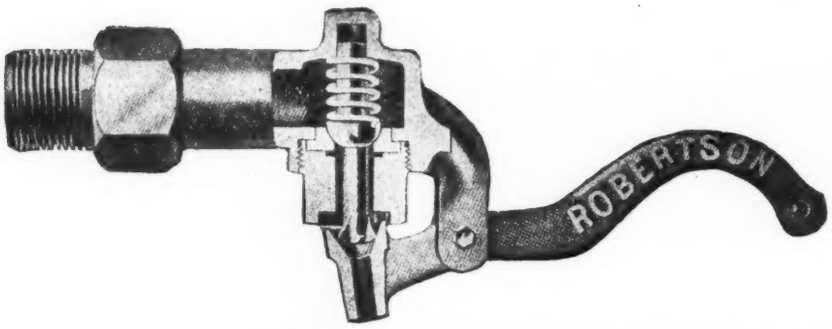
The Robertson Vertical Valve Gauge Cock

has valve and seat of Monel Metal

Monel Metal has demonstrated its superiority in actual service, for withstanding temperatures and alkaline waters.

John F. Robertson Company

1001 Park Bldg., Pittsburgh, Pa.



Your request brings Bulletin No. 23

GOETZE No. 2 GASKETS

Those alternate walls of metal and asbestos will stand between you and loss through steam leakage and shutdowns.

Instead of requiring frequent renewal "Goetze Gaskets" last for years, and may be used over and over again.

A large New Jersey Chemical Co. writes: "We have not ordered gaskets recently—we have had no requisitions for them. The service and quality of gaskets purchased from you in the past are the causes."

The solution of every modern gasket problem! Yours?

GOETZE GASKETS

are for numerous purposes, such as: Acid Lines, Aeroplane Motors, Air and Ammonia Compressors, Alcohol Lines, Benzol and Toluol Stills, Boiler Domes, Boilers, stationary; Boilers, marine; Chemical Lines, Coke Oven By-product Plants, Condensed Water Lines, Condenser Joints, Cylinder Heads, Diesel Engines, Distillers, Economizers, Flanged Joints, Handholes, Heaters, Locomotives, Manholes, Oil Engines, Oil, hot or cold; Pumps, Steam and Gas Engines, Steam Chests, Steam Hammers, Steam Shovels, Steam Traps, Stills and Tanks, Submarines, Superheaters, Tractors, Unions, Valve Bonnets, Water Tube Boilers.

Sent on 90 days free trial.

Ask us to send details on Goetze Copper Valve Gaskets, Goetzerit Sheet Packing and other Goetze Products.

GOETZE GASKET & PACKING CO.

15 Allen Ave., New Brunswick, New Jersey

Ross

Surface Barometric and Jet Condensing Equipments for Power Plants. Main, Auxiliary, Distilling Condensers & Evaporators for Marine Service. Distilling Condensers for Refrigeration and Chemical Plants.

"Crosshead Guided" Expansion Joints. Ross Boiler Feed Water Heaters. Ross Oil and Sugar Juice Heaters. Gravity & Forced Circulation Heaters. Ross Oil, Air and Water Coolers.

ROSS HEATER & MFG. CO., Buffalo, N. Y.

THE BRAND THAT LEADING ENGINEERS DEMAND

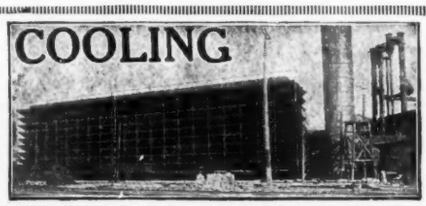
Monel metal

INCO MONEL METAL TRADE MARK

Non-corrodible—strong as steel—tough and ductile. Withstands acids, high temperatures, erosive action of hot gases and superheated steam.

THE INTERNATIONAL NICKEL COMPANY
43 Exchange Place - - - New York, N. Y.

COOLING

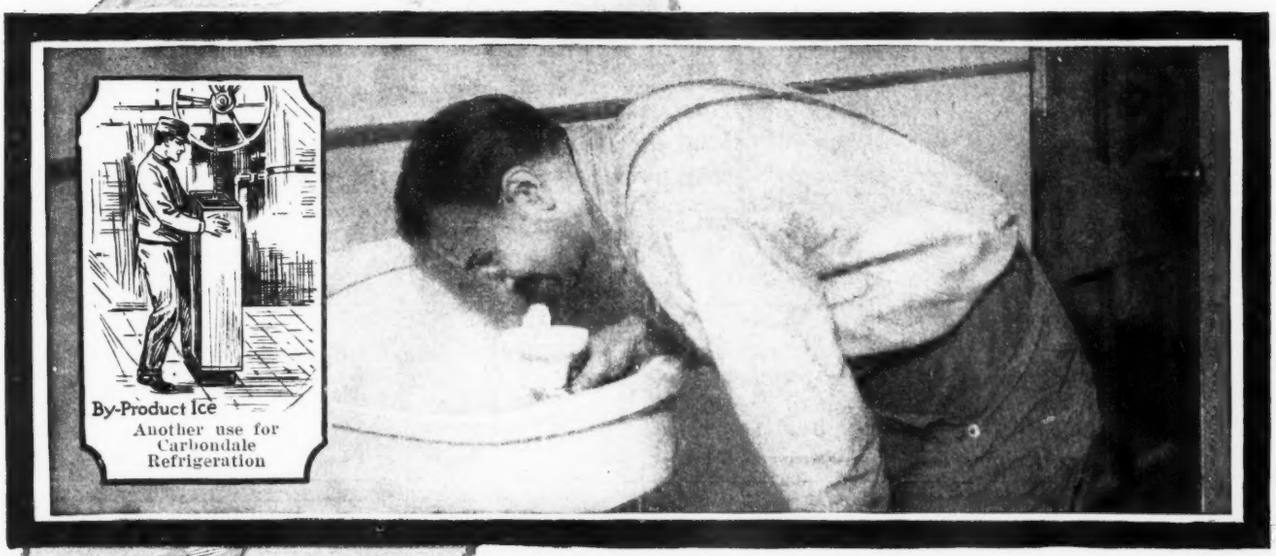


Towers, Nozzles and other water cooling appliances.

Write for Catalog

The Cooling Tower Company

15 John St., N. Y. C.



Use Exhaust Steam to Cool Drinking Water for Employes

Cool drinking water for employes is a welfare feature that is appreciated, and one that pays big returns to the management. It keeps the workers fresh, enabling them to produce more work. The Carbondale Exhaust Steam Absorption System of Refrigerating cools drinking water with exhaust steam that would otherwise be wasted.

By-Product Ice

is another use for Carbondale Exhaust Steam Absorption Refrigerating Machinery, producing tons of ice every day for a few cents a ton.

Industrial Refrigeration

offers possibilities in many fields for cooling, temperature control, solvent recovery and crystallization, replacing other processes used heretofore.

Write Our Nearest Office for Bulletins and Names of Users

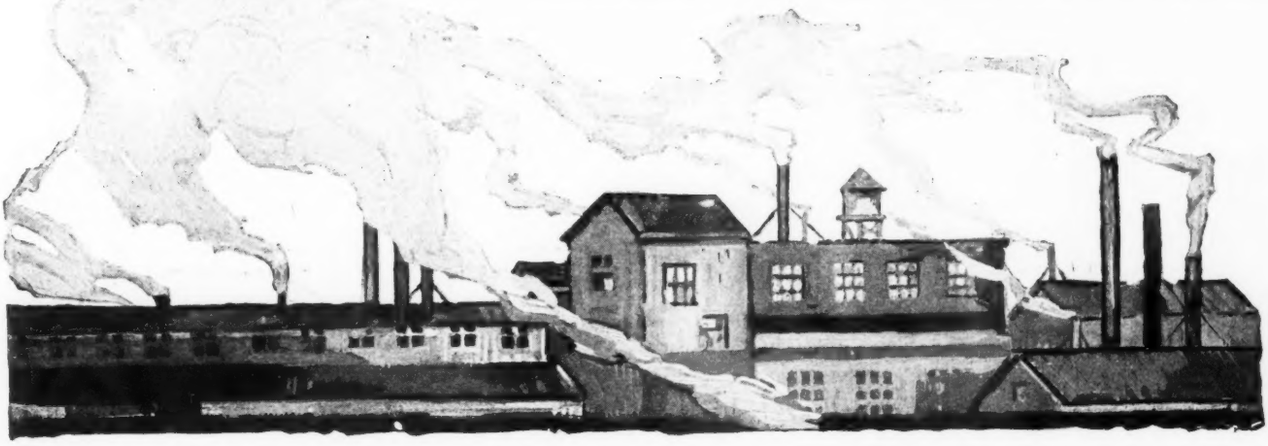
Carbondale Machine Company, Carbondale, Pa.

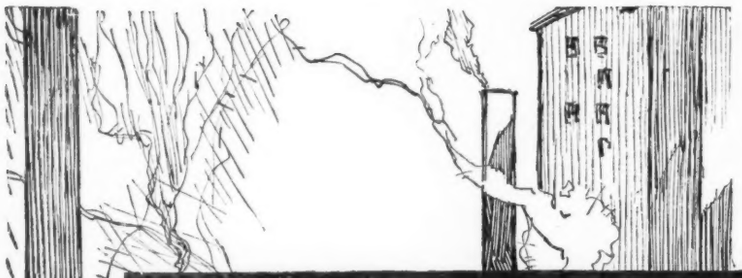
BRANCH OFFICES: **New York, N. Y.**, 171-3-5 Christopher St.; **Baltimore, Md.**, 304 Continental Bldg.; **Philadelphia, Pa.**, 1009 Harrison Bldg.; **Louisville, Ky.**, 217 Norton Bldg.; **Chicago, Ill.**, 1225 Manhattan Bldg.; **New Orleans, La.**, 904 Title Guaranty Bldg.; **Pittsburgh, Pa.**, 1122 Allegheny Ave.; **Buffalo, N. Y.**, 380 Ellicott Square Bldg.

CARBONDALE

Refrigerating and Ice Making Machinery

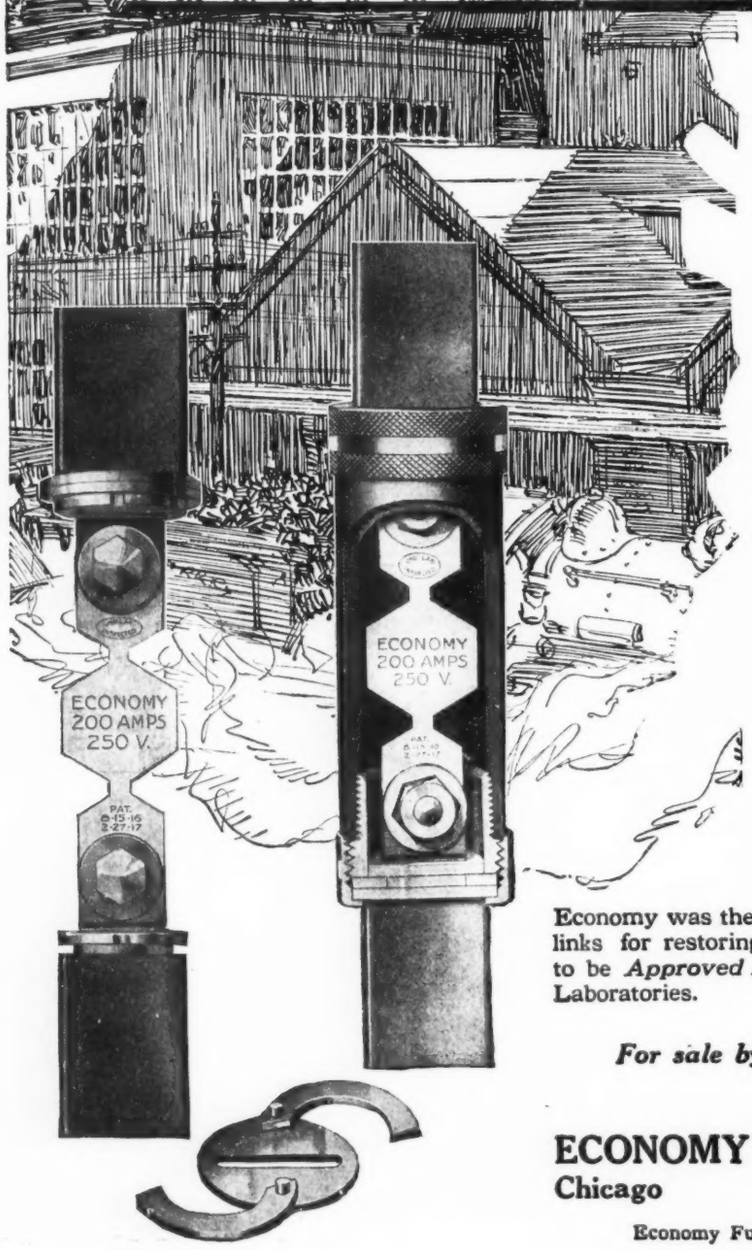
Exhaust Steam Absorption and Ammonia Compression Systems





Where every working minute means money, blown fuses cut profits unless electrical circuits are protected by

ECONOMY *renewable* FUSES



Industries using electrical energy operate more efficiently when delays in machine operation are unnecessary while blown fuses are being replaced.

Economy Fuses are used by thousands of industries because they permit of renewal in minimum time at minimum cost.

Where greater efficiency is required a reserve stock of fuses is kept on hand and used in case of blowouts. The blown fuse then is restored to duty at leisure by simply inserting a new Economy "Drop Out" Renewal Link.

Economy Fuses cut annual fuse maintenance costs 80% as compared to the use of "one-time" fuses.

The fibre cartridge, the winged washers which lock the fuse, and the threaded end caps which complete the assembly are virtually indestructible and are used over and over again.

Economy was the first line using inexpensive bare renewal links for restoring blown fuses to their original efficiency to be *Approved In All Capacities* by the Underwriters Laboratories.

For sale by all leading electrical jobbers and dealers

ECONOMY FUSE & MFG. COMPANY
Chicago - - - - U. S. A.

Economy Fuses are also made in Canada at Montreal

ADAPTiBOXES

The only conduit fitting which gives you the utmost from your wiring system and permits changes and extensions without disturbing origina' installation. **Write for Catalog.**

Type 3200
THE ADAPTi COMPANY, CLEVELAND

Specify
SUNDH Electric Control Equipment
Designed to insure accurate control and economical operation of pumps, fans, blowers, cranes, elevators and all other electric drives. Send us your requirements.
Sundh Electric Co. Avenue C and Parkhurst St. Newark, N. J.

"UNION" FUSES
are made in both renewable and non-renewable types. Guaranteed to give satisfaction. Money back if they fail. Booklet on request.
CHICAGO FUSE MFG. CO.
Chicago New York

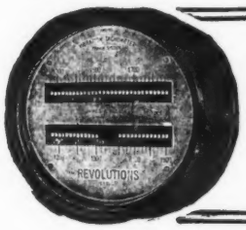
SHEPARD
ELECTRIC CRANE & HOIST CO.
Literature or Service on request
Montour Falls, N. Y.
New York Philadelphia Chicago Pittsburgh Boston Baltimore Cleveland San Francisco Montreal Melbourne London

HAYWARD ELECTRIC MOTOR BUCKET

First aid to overworked labor and overburdened payroll. Self-contained, easily and fully controllable, speedy digging and rehandling machine for indoor and outdoor use. Hooked up in a jiffy to any lifting machine. Catalog 44.
THE HAYWARD CO., 44-50 Church St., New York

CROCKER-WHEELER MOTORS
"Niagara's Rival for Dependable Power"

CROCKER-WHEELER CO.
Ampere, N.J.



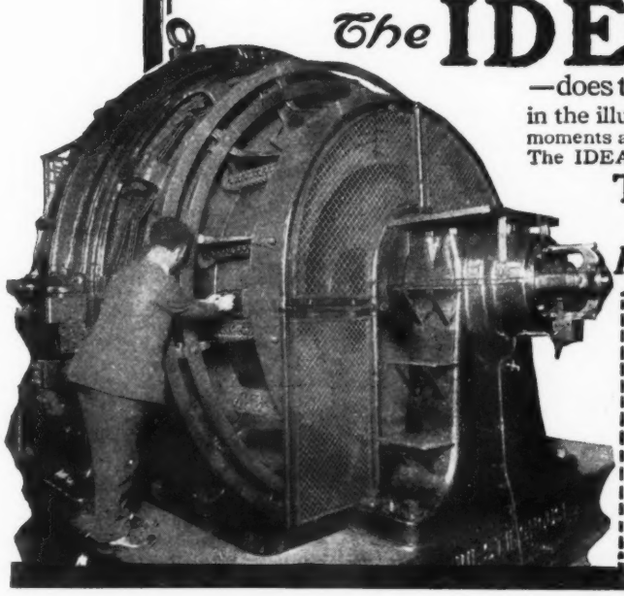
Absolutely *"the best"* speed indicator for permanent attachment to a steam turbine or any other prime mover which operates between 900 and 8000 r.p.m., is our
FRAHM Vibrating-Reed TACHOMETER
This instrument is *"entirely different,"* and deserves fullest investigation. Used by U. S. Government and all standard turbine builders. *Write for Catalog* 853.
JAMES G. BIDDLE, 1211-13 Arch Street, Philadelphia

Grind Down Your Commutators in Place

—with an abrasive tool—a manufactured composition in block form which when held against revolving commutators, grinds down irregularities and stops sparking and loss of power.

An **IDEAL**

The IDEAL COMMUTATOR RESURFACER



—does the trick. An occasional application, as shown in the illustration, stops sparking and loss of power in a few moments and saves many dollars spent for resurfacing by other methods. The IDEAL never clogs and always cuts evenly.

Try One Out Without Cost

Our Free Trial Plan is explained on the Coupon.

Fill It Out and Mail It Today!

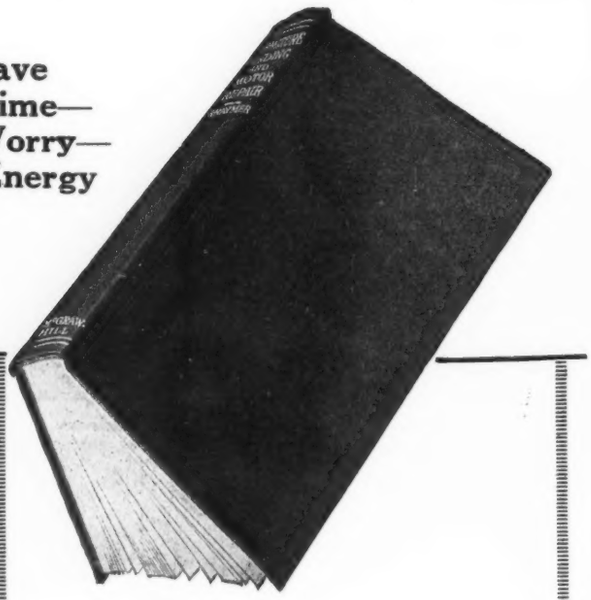
IDEAL COMMUTATOR DRESSER CO., PG-29-20
2 South Dearborn Street, Chicago

Gentlemen:—Please send me an Ideal Commutator Resurfacer for free trial. If I am not fully satisfied with it I will return it collect at no expense to me. I want to use it on equipment as follows:

Approx. R. P. M..... Diameter of Commutator or Ring.....
Approx. width of Commutator or ring surface .....
Approx. distance between brush sets..... Condition.....
Ring material (copper, steel, etc.).....
My name is..... Position.....
Company..... Company address.....
City..... State.....

Practical Armature Winding

Save Time— Worry— Energy



You are called to repair a motor or generator. The trouble is there, but how to find and fix it is up to you. That's when you need this new and accurate guide on

Armature Winding
AND
Motor Repair

By D. H. BRAYMER

500 *pages, 6 x 9, illustrated,* $3.00 *net, postpaid.*

Don't limit yourself by your own experience. Here is a compilation of practical methods that are in present use by repairmen and armature winders on every kind of job. Common-sense data, not a theoretical discussion of armature winding design. Only such material which describes in detail the methods found by actual experience to represent the best repair shop practice has been included in this new handbook. It's the "how-to-do-it" book for your daily use.

Try these helpful kinks on the job

Save time, worry, and energy for ten days free, and then decide whether or not you want to keep the book. Send the free examination coupon now.

MAIL THIS COUPON TODAY

McGraw-Hill Book Co., Inc.,
239 West 39th Street, New York, N. Y.

You may send me on 10 days' approval **Braymer's Armature Winding and Motor Repair, $3.00 net, postpaid.** I agree to pay for the book or return it postpaid within 10 days of receipt.

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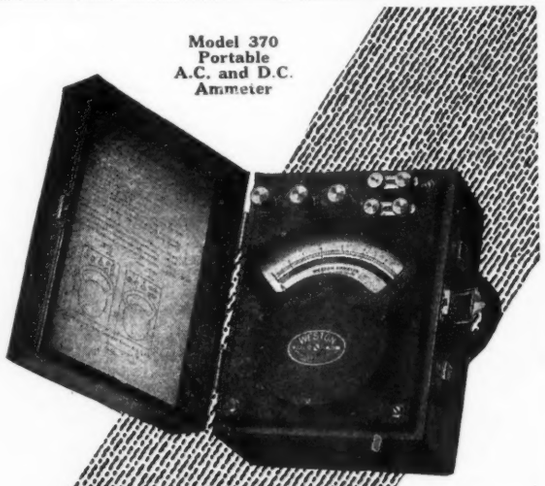
P 6-29-20

Model 370
Portable
A.C. and D.C.
Ammeter



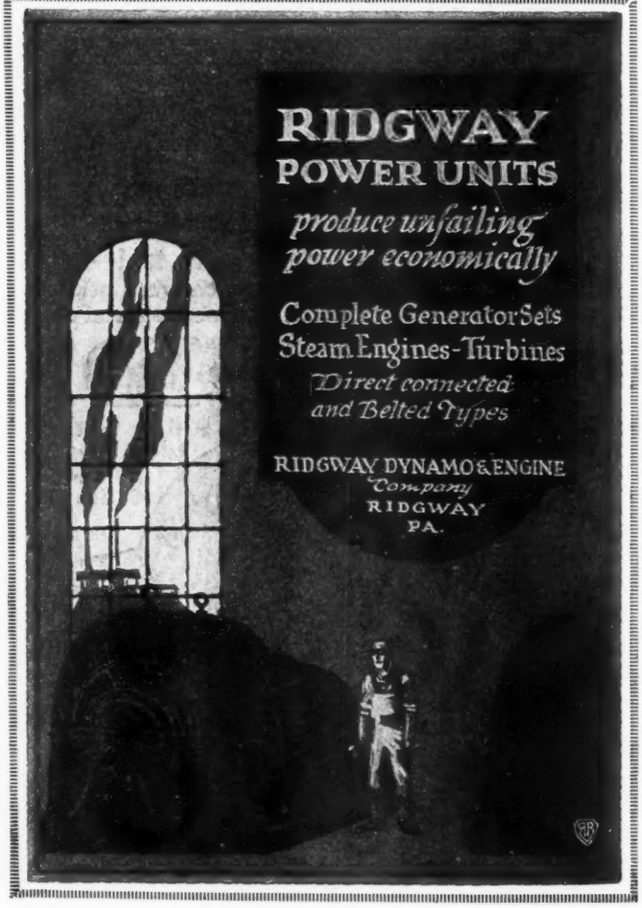
Weston

ELECTRICAL INDICATING INSTRUMENTS
are unqualifiedly superior in construction, accuracy and service to any other Instruments designed for the same purposes.

Weston models include complete Switchboard and Portable groups for service on A.C. or D.C. circuits, and also many Instruments designed for special purposes. There is a Weston model for every electrical measurement need.

Write for catalog or bulletin, specifying the field that interests you.

WESTON ELECTRICAL INSTRUMENT CO.
137 Weston Ave., Newark, N. J.

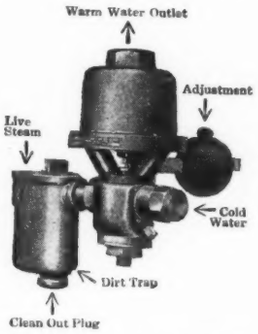


Make High Priced Labor Earn Its Pay!

Don't pay a man high wages to do the work that a machine can do better. Put him at a task where he can *earn* the high wages you pay him.

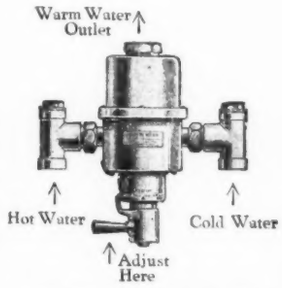
Let An Automatic Machine Do the Automatic Job

Manual control of temperatures is never dependable—always expensive.



The Powers Thermostatic Steam and Water Mixer

The simplest and least expensive installation for supplying hot water. Automatically mixes high pressure steam and cold water, giving desired temperature at outlet. Adapted to wash sinks, shower baths, etc. Absolute protection against scalding.



The Powers Thermostatic Water Controller.

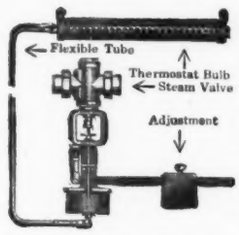
A true thermostatic controller mixing hot and cold water and maintaining desired temperature at outlet, regardless of varying temperature or pressure of either hot or cold water supply. For wash sinks, shower baths, hot water lines, etc. Saves fixtures and prevents possible scalding.

Powers Automatic Regulators will control the heat better, more surely, and for less money.

Put Powers Regulators on these jobs and let your operators give *all* their time and thought to the work a machine *can't* do.

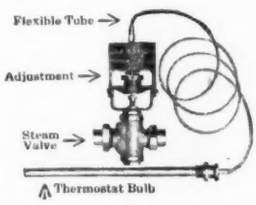
Don't deceive yourself into believing the operator or tender spends no valuable time in regulating the heat. He *does*. If he *doesn't*, the heat varies, and loss and damage result.

Heat regulation has been our sole business for over thirty years. No matter what failures others may have made, *Powers Regulators do not fail.*



The Powers No. 15 Regulator

A self-contained thermostatic regulator for control of atmospheric temperature. Readily set for any desired degree by moving weight on lever. Particularly effective in drying rooms. Controls temperature accurately, preventing overheating of fabric.



The Powers No. 11 Regulator.

A self-contained thermostatic regulator for control of liquid temperatures. Readily set for any desired degree by spring adjustment, or lever and weight. Particularly adapted to controlling liquid temperatures as in glue pots, dye kettles, acid baths, hot water tanks, washing machines etc.

Try This Plan At Our Risk

We will send you a Powers Regulator for you to try out in your own way. You may keep it 30 days, and then if you don't feel satisfied with results, you may send it back and we will cancel the charge.

The Powers Regulator Co.

Specialists in Automatic Heat Control

980 Architects Bldg., New York **2771 Greenview Ave., Chicago** **322 The Federal St. Bldg., Boston**

The Canadian Powers Regulator Co., Ltd., Toronto, Ont.

(1405)

WHAT AND WHERE TO BUY

Equipment, Apparatus and Supplies Used in the Power Plant Field with Names of Manufacturers and Distributors

Please refer to the Buying Section for addresses of concerns listed in this directory.
See Last Page for Alphabetical Index

Air Aftercoolers and Receivers
Ingersoll-Rand Co.
Lancaster Iron Works

Air Compressors
Allis-Chalmers Mfg. Co.
Chicago Pneumatic Tool Co.
De La Vergne Machine Co.
Fairbanks, Morse & Co.
General Electric Co.
Ingersoll-Rand Co.
Nordberg Mfg. Co.
Norwalk Iron Wks.
Pennsylvania Pump & Compressor Co.
Sullivan Machinery Co.
Weber Subterranean Pump Co.
Worthington Pump & Mach. Corp.

Air Separators
Griscom-Russell Co.

Air Washers
Badger & Sons Co., E. B.
Carrier Air Conditioning Co.
Spray Engineering Co.

Alarms, Low Water
Elliott Co.
Lunkenheimer Co.
Reliance Gauge Column Co.

Alternators, Turbo
Allis-Chalmers Mfg. Co.
General Electric Co.
Kerr Turbine Co.
Moore Steam Turbine Corp.
Ridgway Dynamo & Eng. Co.
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.

Ammeters
Brown Inst. Co.
Weston Elec. Inst. Co.

Arc, Welding
Wilson Welder & Metal Co.

Arches, Boiler Furnace
(See Boiler Arches and Setting)

Asbestos Brake Band Lining and Brake Blocks
Gen'l Asbestos & Rubber Co.
Johns-Manville

Asbestos Materials
Dominion Asbestos & Rubber Co.

Ash Bin Gates
(See Gates Bin)

Ash and Coal Handling Machinery
(All Coal and Ash Handling Machinery)

Ash Cans
Gillis & Geoghegan

Ash Gates
Gillis & Geoghegan
Washburn & Granger, Inc.

Ash Pit Doors
Amer. Steam Conveyor Corp.
Green Engr. Co.

Ash Tanks, Cast Iron
Green Engineering Co.

Ash Tanks, Steel
Heine Safety Boiler Co.

Auto Accessories
Dominion Asbestos & Rubber Corp.

Babbitt
Amer. Crucible Products Co.

Balanced Draft
Engineer Co.

Barometers
Brown Instrument Co.
Taylor Instrument Co.

Batteries, Dry
National Carbon Co.

Batteries, Storage
National Carbon Co.

Bath Heaters
Griscom-Russell Co.

Bearing Metal
Amer. Crucible Products Co.

Bearings, Oilless
Bound Brook Oilless Bearings

Bearing, Thrust
Albert Kingsbury

Belt Cement
Chas. A. Schieron Co.

Belt Dressing
Cling-Surface Co.
Dixon Crucible Co., Jos.
Keystone Lubricating Co.
Rhoads & Sons, J. E.
Schieren Co., Charles A.
Texas Co., N. Y. C.

Belting
Pioneer Rubber Works
Carpenter Co., Geo. B.
Diamond Rubber Co.
Garlock Packing Co.
Greene, Tweed & Co.
Goodrich Rubber Co., B. F.
Goodyear Tire & Rubber Co.
Jewell Belting Co.
Jeffrey Mfg. Co.
Ladew Co., Inc., E. R.
Link-Belt Co.
N. Y. Belting & Packing Co.
Quaker City Rubber Co.
Rhoads & Sons, J. E.
Schieren Co., Charles A.
United States Rubber Co.

Belting, Balata
Dominion Asbestos & Rubber Corp.

Belting, Canvas Stitched
Dominion Asbestos & Rubber Corp.

Belting, Conveyor
Dominion Asbesos & Rubber Corp.
Chain Belt Co.
Gifford-Wood Co.
Goodrich Rubber Co., B. F.
Goodyear Tire & Rubber Co.
Jeffrey Mfg. Co.
Link-Belt Co.
N. Y. Belting & Packing Co.
Pioneer Rubber Mills, San Francisco

Belting Leather (Waterproof)
Bond Co., Chas. P.
Schieren Co., Chas. A.

Belting, Link Leather
Schieren Co., Chas. A.

Belting, Rubber
Dominion Asbestos & Rubber Corp.

Bins
Brown Hoisting Mchy. Co.
Green Engr. Co.
Weiderholt Construction Co.

Blast Gates
Clarage Fan Co.

Blowers, Centrifugal
Coppus Eng'g & Equip. Co.
General Electric Co.
Green Fuel Economizer Co.
Sterling Blower Co.

Blowers, Fan
American Blower Co.
Buffalo Forge Company
Carling Turbine Blower Co.
Coppus Eng'g & Equip. Co.
Clarage Fan Co.
De Laval Steam Turbine Co.
Engineer Co.
General Electric Co.
Green Fuel Economizer Co.
Green Engr. Co.
Griscom-Russell Co.
Power Turbo Blower Co.
Sterling Blower Co.
Sturtevant Co., B. F.
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.
Wing Mfg. Co., L. J.

Blowers, Forced Draft
Clarage Fan Co.
Coppus Eng'g & Equip Co.
Marion Mch., Fdry. & Supply Co.
Sterling Blower Co.

Blowers, Soot
Bayer Steam Soot Blower Co.
Diamond Power Spec. Co
The Paul B. Huyette Co.
Marion Mch., Fdry. & Supply Co.

Blowers, Steam Jet
Chesterton Co., A. W.
McClave-Brooks Co
Marion Mch., Fdry. & Supply Co.
Schutte & Koerting Co
Sterling Blower Co.

Blowers, Turbine
Carling Turbine Blower Co.
Coppus Eng'g & Equip. Co.
Ingersoll-Rand Co.
Kerr Turbine Co.
Wing Mfg. Co., L. J.

Boiler Arches and Setting
Bernitz Furnace Appliance Co., Boston
Betson Plastic Fire Brick Co.
Botfield Specialties Mfg. Co.
M. H. Detrick & Co.
Rust Engr. Co.
A. P. Green Fire Brick Co.
Green Engr. Co.
Hagan Corporation
Harbison-Walker Refractories Co.
International Engineering Works
Jointless Fire Brick Co.
McLeod & Henry Co.
Obermayer Co., The S.
Rust Engr. Co.
Walsh Fire Clay Prod. Co.
Washburne & Granger, Inc.

Boiler Baffle Walls
Betson Plastic Fire Brick Co.
Engineer Co., The
Johns Manville Co.
Jointless Fire Brick Co.
McLeod & Henry
Walsh Fire Clay Prod. Co.

Boiler Compound
Bird-Archer Co., The
McLeod & Henry
Dearborn Chemical Co.
Dixon Crucible Co., Jos.
Hawkeye Compound Co.
Perolin Co. of America

Boiler Feed Pumps
(See Pumps, Boiler Feed)

Boiler Feed Water, Make Up Plants
Griscom-Russell Co.

Boiler Feed Water Purifying Apparatus
Permutit Co.

Boiler Furnace Linings
Betson Plastic Fire Brick Co.
Botfield Specialties Mfg. Co.
A. P. Green Fire Brick Co.
Jointless Fire Brick Co.
King Refractories Co.
Obermayer Co. The S.
McLeod & Henry
Walsh Fire Clay Prod. Co.

Boiler Graphite
Dixon Crucible Co. Jos.

Boiler Skimmers
Yarnall-Waring Co.

Boiler Tube Cap Reseating Machine
Lagonda Mfg. Co.

Boiler Tube Cleaners
(See Blowers Soot)
(See Scale Removers)

Boiler Tube Protectors
Cruise & Co.

Boiler Tube Welding
McEwen Bros.
General Specialty Co., The

Boiler Tubes
Amer. Tube & Pipe Bend. Co.
Boiler Tube Co. of America
McEwen Bros.
National Tube Co.
Yarnall-Waring Co.

Boilers, Internally Fired
Casey-Hedges Co., The
Fitzgibbons Boiler Co.

Boilers, Return Tubular
Bigelow Co., Philadelphia
Carpenter Co., Geo. B.
Coatesville Boiler Works
McEwen Bros.

Boilers, Vertical Water Tube
Erie City Iron Works
Edge Moor Iron Works
Casey-Hedges Co., The
Ladd Co., Geo. T.
McEwen Bros.
Marion Mch., Fdry. & Supply Co.
Morrin Climax Boiler Co.
Page Boiler Co.
Springfield Boiler Co.
Union Iron Works
Vogt Mach. Co. Henry
Wickes Boiler Co.

Boilers, Water Tube
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The
E. Keeler Co.
Badenhausen Co.
Casey-Hedges Co., The
D. Connelly Boiler Co.
Heine Safety Boiler Co., St. Louis
International Engineering Works
Ladd Co., Geo. T.

Bolts and Nuts, Monel Metal
The International Nickel Co.

Books
McGraw-Hill Book Co., Inc.

Breechings
Lancaster Iron Works

Brick, Fire
Bernitz Furnace Appliance Co.-
Betson Plastic Fire Brick Co.
Botfield Specialties Mfg. Co.
Green Engineering Co.
A. P. Green Fire Brick Co.
Harbison-Walker Refractories Co.
Jointless Fire Brick Co.
McLeod & Henry Co.
Obermayer Co., The S.
Taylor Sons Co., Chas.
Walsh Fire Clay Prod. Co.

Brick Fire Cement
King Refractories Co.

Brushes, Motor and Generator
Dixon Crucible Co., Joseph
Calebaugh Self Lubr. Carbon Co.
National Carbon Co.
Orton & Steinbrenner Co.
Speer Carbon Co.
Westinghouse Elec. & Mfg. Co.

Bucket Carrier, Pivoted
Jeffrey Mfg. Co.
Link-Belt Co.
Webster Mfg. Co.

Buckets, Clam Shell
Blaw-Knox Co.
Brosius Co., Edgar
Brown Hoisting Mchy. Co.
Link-Belt Co.
Orton & Steinbrenner

Burners, Oil (See Oil Burners)

Bushings
Steel Mill Pkg. Co.

Car Wheels
Amer. Pulley Co.

Castings, Acid Resistant
Howard Iron Works

Castings, Brass and Iron
Builders Iron Foundry
Hercules Float Works
McClave-Brooks Co.
Neemes Bros.
Nelson Valve Co.

Castings, Grey Iron
Norwalk Iron Works

Castings, Monel Metal
International Nickel Co.

Caustic Soda Cells
National Carbon Co.

Cellar Drainers
Penberthy Injector Co.

Cement, Iron
Smooth-On Mfg. Co.

Cement, Pipe Joint
Dixon Crucible Co., Jos.
Smooth-On Mfg. Co.

Centrifugal Pumps (See Pumps, Centrifugal)

Chain, Wheel Valve
Babbit Steam Specialty Co.

Chain, Monel Metal
International Nickel Co.

Chains, Block
Link-Belt Co.

Chain Drive
Chain Belt Co.
Jeffrey Mfg. Co.
Link-Belt Co.

Chimney Cans
Globe Ventilating Co.

Chimneys, Brick and Concrete
Rust Engr. Co.
Wiederholt Construction Co.

Chimneys, Radial Brick
Kellogg Co., M. W.
Rust Engr. Co.

Circulating System for Lubricating Oil
Bowser & Co., S. F.
Wayne Oil Tank & Pump Co.

Clamps
Yarnall-Waring Co.
Williams & Co., J. H.

Clamps, "C"
Williams & Co., J. H.

Clamps, Hose
Strong, Carlisle & Hammond Co.

Cleaners, Boiler Tube
(See Blowers, Soot)
(See Scale Removers)

Clutches, Friction
W. E. Caldwell Co., Inc.
Carlyle-Johnson Mach. Co.
Fletcher Works
Link-Belt Co.
Moore & White Co.
Reliance Gauge Column Co.

Coal and Ash Handling Machinery
American Steam Conveyor Corp.
Beaumont Co., R. H.
Brady Foundry Co., James A.
Brown Hoisting Mach. Co.
Chain Belt Co.
M. H. Detrick Co.
Gifford-Wood Co.
Girtanner Engr. Corp.
Godfrey Conveyor Corp.
Green Engineering Co.
Guarantee Construction Co.
Hayward Co.
Jeffrey Mfg. Co.
Link-Belt Co
Locomotive Pulverized Fuel Co.
Portable Machinery Co., Inc.
Quigley Furnace Specialties Co.
Richardson Scale Co., Passaic
Sterling Blower Co.
United Stokers Corp.
Webster Mfg. Co.
Williams Patent Crusher & Pulverizer Co.

Coal Bunkers
Beaumont Co., R. H.
Brown Hoisting Machy. Co.
Green Engineering Co.
Guarantee Construction Co.
Link-Belt Co.

Coal Crushers
Beaumont Co. R. H.
Jeffrey Mfg. Co.
Link-Belt Co.
Marion Mch. Fdry. & Supply Co.
Orton & Steinbrenner Co.
Webster Mfg. Co.
Williams Patent Crusher & Pulverizer Co.
Worthington Pump & Mchy. Corp.

Cocks, Brass and Iron Body
Walworth Mfg. Co.

Cocks, Gage
Chaplin Fulton Mfg. Co.
John F. Robertson Co.
Huyette Co., Inc., Paul B.
Jenkins Bros.
Lunkenheimer Co.
Nat'l Flue Cleaner Co.
Ohio Brass Co.
Reliance Gauge Column Co.
S.-C. Regulator Co.

Cocks, Steam
Crane Co.
Dart Mfg. Co., E. M.
Homestead Valve Mfg. Co.
Lunkenheimer Co.

Collars, Shaft
Chain Belt Co.
Chas. P. Bond Co.
Link-Belt Co.

Combustion Chamber, Back Arch
Betson Plastic Fire Brick Co.
A. P. Green Fire Brick Co.
Jointless Fire Brick Co.
McLeod & Henry Co.
Obermayer Co., The S.
Walsh Fire Clay Prod. Co.

CO_2 Recorders and Flue Gas Analysis Instruments
Dwight Mfg. Co.
Foxboro Co., Foxboro, Mass.
Hays Corp., Jos. W.
Mono Co. of Am.
Paul B. Huyette Co.
Pierce Co., Wm. B.
Sarco Company, Inc.
Uehling Instrument Co.

Commutator Compound
Dixon Crucible Co. Jos.
Ohio Grease Co.

Commutator Slotters
Green Equipment Corp.

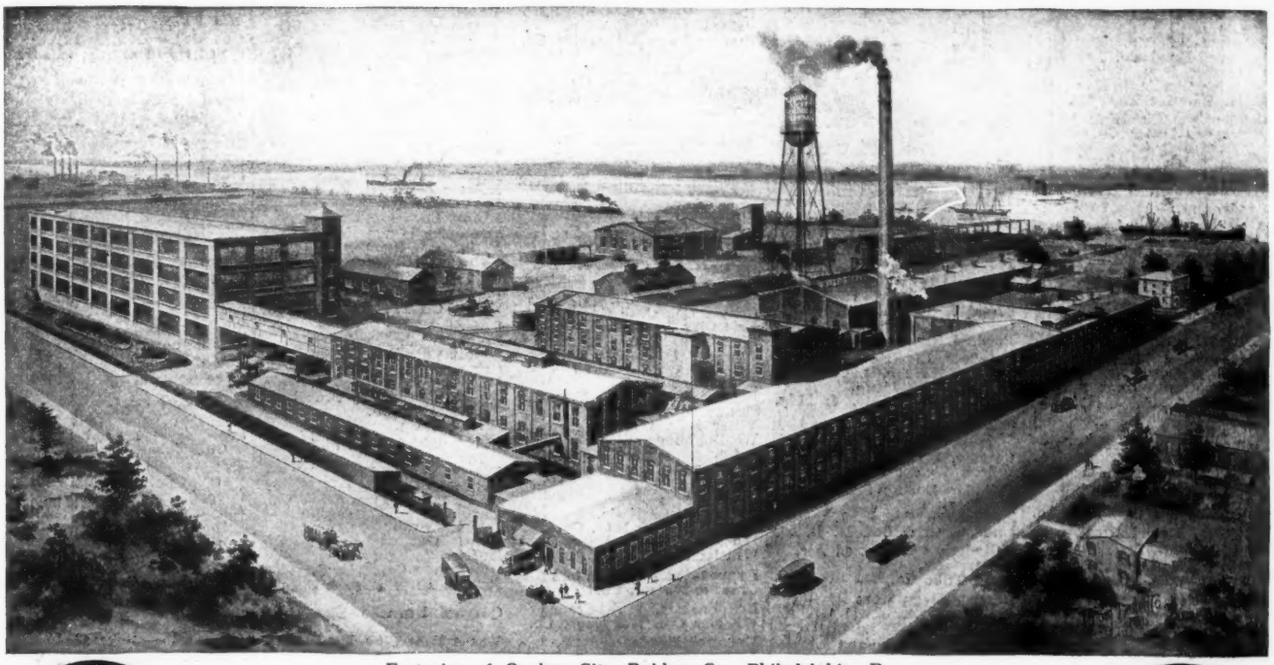
Commutator Stones
Ideal Commutator Dresser Co.
Green Equipment Co.

Commutator Truing Device
Green Equipment Co.

Compressors, Air, Acetylene, Carbonic Acid Gas, etc.
Ingersoll-Rand Co.
Norwalk Iron Works

Condenser Tube Cleaner
Griffin Co., C. M.
Lagonda Mfg. Co.

Condensers
Alberger Heater Co.
Alberger Pump & Cond. Co.
Allis-Chalmers Mfg. Co.
American Well Works
Buffalo Steam Pump Co.
Cameron Steam Pump Wks.
Carbondale Machine Co.
Dean Bros. Stm. Pump Wks.
Elliott Co.
Eynon-Evans Mfg. Co.
Griscom-Russell Co.
Ingersoll-Rand Co.
International Engineering Works
Kellogg Co., W. M.
Manistee Iron Wks.
Ross Heater & Mfg. Co.
Schutte & Koerting Co.
Westinghouse Elec. & Mfg. Co.
Wheeler Cond'r & Engr. Co.
Wheeler Mfg. Co., C. H.
Worthington Pump & Mach. Corp.



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ROD and SHEET PACKINGS for engines, pumps, compressors and other machinery.
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DANIEL'S EBONITE SHEET PACKING
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Lancaster Iron Works
Wheeler Cond'r & Engr. Co.
C. H. Wheeler Mfg. Co.

Condensers, Distilling
Alberger Heater Co.
Albright-Nell Co.
Manistee Iron Works
Ross Heater & Mfg. Co.
Wheeler Cond. & Eng. Co.

Condensers, Jet
Albright-Nell Co.
Ingersoll-Rand Co.
Manistee Iron Works
Wheeler Cond. & Eng. Co.
C. H. Wheeler Mfg. Co.

Condensers, Surface
Ingersoll-Rand Co.
Wheeler Cond. & Eng. Co.
C. H. Wheeler Mfg. Co.

Condensation Meters
(See Meters)

Condensation Pumps
(See Pumps)

Connecting Rods
Williams & Co., J. H.

Connectors, Frankel Solderless
Westinghouse Elec. & Mfg. Co.

Conduit Elbows
Am. Tube & Pipe Bend'g Co.

Conduits, Electrical
Adapti Company

Conduits, Underground
American Dist. Steam Co.

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M. J. Dougherty Co.

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Brown Instrument Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Controllers, Feed Water
(See Feed Water Regulators)

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Barber Greene Co.
Beaumont Co., R. H.
Chain Belt Co.
Goodrich Rubber Co., B. F.
Goodyear Tire & Rubber Co.
Guarantee Construction Co.
Jeffrey Mfg. Co.
Link-Belt Co.
Portable Machinery Co., Inc.
United States Rubber Co.

Conveyors, Cable
Lancaster Iron Works

Conveyors, Clinker and Cinder
(See Coal and Ash Handling Machinery)

Conveyors, Coal and Ash
(See Coal and Ash Handling Machinery)

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Carbondale Machine Co.
Griscom-Russell Co.

Coolers, Inter and After
Alberger Heater Co.
Schutte & Koerting Co.

Coolers, Oil
Alberger Heater Co.
Alberger Pump & Condenser Co.
Schutte & Koerting Co.

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Badger & Sons Co., E. B.
Spray Engineering Co.
Star Brass Works
Yarnall-Waring Co.

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Badger & Sons Co., E. B.
Burhorn Co., Edwin
Carbondale Machine Co.
Cooling Tower Co.
De La Vergne Mach. Co.
Stocker, George J.
Wheeler Mfg. Co., C. H.
Wheeler Cond. & Engr. Co.
Wiederholt Construction Co.
Worthington Pump & Mchy. Corp.

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Couplings, Flexible Shaft
Bartlett Hayward Co.
Chain Belt Co.
Chas. P. Bond Co.
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Smith & Serrell

Couplings, Friction Coil
Karge-Baker Co.

Couplings, Rigid
Smith & Serrell

Couplings, Shaft
Karge-Baker Co.
Smith & Serrell
W. H. Nicholson & Co.

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Betson Plastic Firebrick Co.
Botfield Specialties Mfg. Co.
Excello Mfg. Co.
Hagen Corporation, The
Jointless Fire Brick Co.
The Paul B. Huyette Co.
Obermayer Co., The S.

Covering, Pipe and Boiler
Johns-Manville
Magnesia Assn. of America
Ric-Wil Co.

Covering, Underground Steam Pipe
Johns-Manville, N. Y.
Ric-Wil Co.

Cranes
Brown Hoisting Mach. Co.
Chas. P. Bond Co.
Godfrey Conveyor Corp.
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Orton & Steinbrenner Co.
Shepard Electric Crane & Hoist Co.

Crankpin Turning Machines, Portable
Underwood & Co., H. B.

Crankshafts
Williams & Co., J. H.

Crankshaft Repairs
Metal & Thermit Corp.

Crucible Lining
Botfield Specialties Mfg. Co.

Cut-Outs, Electric
Chicago Fuse Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Cutters, Boiler Tubes
(See Pipe Cutters)

Cutting, Electric Arc
Wilson Welder & Metal Co

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Rooksby & Co., E. J.
Underwood & Co., H. B.

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Nat'l Tube Co.

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Hess & Barker

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Farnsworth Company
Underwood & Co., H. B.

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Borden Co., The
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Toledo Pipe Theading Mach. Co.

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Whitlock Coil Pipe Co.

Distilling Plants (Water)
Griscom-Russell Co.

Draft, Mechanical
(See Blowers, Fan)

Drills
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Jeffrey Mfg. Co.
Terry Steam Turbine Co.

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Barnes Co., W. F. & John

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Williams & Co., J. H.

Dust Collectors
Clarage Fan Co.
Sturtevant Co., B. F.

Dynamos (See Generators)

Economizers, Fuel
Green Fuel Economizer Co.
Sturtevent Co., B. F.

Ejectors
American Injector Co.
Chaplin-Fulton Mfg. Co.
Hancock Inspirator Co.
Hayden & Derby Mfg. Co.
Lunkenheimer Co.
Penberthy Injector Co.
Schutte & Koerting Co.

Electric Wires and Cables
American Steel & Wire Co.

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Jeffrey Mfg. Co.
Link-Belt Co.
Orton & Steinbrenner

Elevators and Elevator Service
Otis Elevator Co.

Engineering Service
(See Directory)

Engine, Hoisting
Carpenter Co., Geo. B.
Nordberg Mfg. Co.

Engine Repairs
Dodge Sales & Eng. Co.
Hess & Barker, Phila.
Lammert & Mann Co.
Rooksby & Co., E. J.
Underwood & Co., H. B.

Engine Stops
Jenkins Machine Co.
Schutte & Koerting Co.
Strong Carlisle & Hammond Co. The

Engines, Diesel
Allis-Chalmers Mfg. Co.
Buckeye Machine Co.
Busch-Sulzer
McEwen Bros.
McIntosh & Seymour Corp.
Midwest Engine Co.
Nordberg Mfg. Co.
Worthington Pump & Mchy. Corp.

Engines, Gasoline
Fairbanks, Morse & Co.
Sterling Engine Co.

Engines, Gas and Oil
Buckeye Engine Co.
Buckeye Machine Co.
Chicago Pneumatic Tool Co.
Cooper Co., C. & G.
De La Vergne Mach. Co.
Fairbanks, Morse & Co.
Hooven-Owen-Rentschler Co.
Ingersoll-Rand Co.
Power Mfg. Co., The
Western Machinery Co.
Westinghouse Elec. & Mfg. Co.

Engines, Pumping
Allis-Chalmers Mfg. Co.
Morris Machine Works
Nordberg Mfg. Co.
Worthington Pump & Mach. Corp.

Engines, Steam
Allis-Chalmers Mfg. Co.
American Blower Co.
Badenhausen Co.
Ball Engine Co.
Buckeye Engine Co.
Buffalo Forge Co.
Cooper Co., C. & G.
Erie City Iron Works
Fitchburg Steam Engine Co.
Hooven-Owen-Rentschler Co.
Morris Machine Works
Nordberg Mfg. Co.
Ridgway Dynamo & Eng. Co.
Skinner Engine Co.
Vilter Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Worthington Pump & Mchy. Corp.

Evaporators
Griscom-Russell Co.
Ross Heater & Mfg. Co.
Wheeler Cond. & Engr. Co.
Whitlock Coil Pipe Co.

Evaporator Feed Heaters
Griscom-Russell Co.

Evaporators, Multi-Stage
Wheeler Cond. & Engr. Co.

Exhaust Heads
Burt Mfg. Co.
Direct Separator Co
Hoppes Mfg. Co.
Ohio Body & Blower Co.
Patterson & Kelley Co., Inc.
Sterling Blower Co.
Sturtevant Co., B. F.
Watson & McDaniel Co.
Whitlock Coil Pipe Co.
Wright-Austin Co.

Expansion Joints
Alberger Pump & Condenser Co.
American Dist. Steam Co.
Badger & Sons Co., E. B.
Griscom-Russell Co.
Hercules Float Works
Howard Iron Works
Kelly & Jones
Ross Heater & Mfg. Co.
Webster & Co., Warren
Wheeler Mfg. Co., C. H.

Extension Valve Boxes
Kennedy Valve Mfg. Co.

Fans, Exhaust and Ventilator
(See Blowers, Fan)

Feed Water Filters
(See Filters, Feed Water)

Feed Water Heaters
Alberger Heater Co.
Alberger Pump & Cond. Co.
American Blower Co.
Elliott Co.
Griscom-Russell Co.
H. S. B. W. Cochrane Corp. (Formerly Harrison Safety Boiler Works)
King Construction Co.
Nat'l Pipe Bending Co.
Ohio Body & Blower Co.
Patterson Kelley Co.
Permutit Co.
Pratt & Cady Co.
Ross Heater & Mfg. Co.
Webster & Co., Warren
Wheeler Cond. & Engr. Co.
Worthington Pump & Mchy. Corp.

Feed Water Purifiers
Alberger Heater Co.
Blackburn Smith Corp.
H. S. B. W. Cochrane Corp. (Formerly Harrison Safety Boiler Works)
International Filter Co.
Pratt & Cady Co., Inc.
Webster & Co., Warren
Yarnall-Waring Co.

Feed Water Regulators
Am. Steam Gauge & Valve Mfg. Co.
Chaplin-Fulton Mfg. Co.
D'Este Co., Julian
Elliott Co.
Foster Engineering Co.
Mason Regulator Co.
McDonough Automatic Regulator Co.
Northern Equipment Co.
S.-C. Regulator Co.
Squires Co., C. E.
Wing Mfg. Co., L. J.
Wright Austin Co.

Feeders, Boiler Compound
Bird-Archer Co., The
Lunkenheimer Co.
Richardson-Phenix Co.

Fibre, Sheets, Rods, Tubes and Specialties
Wilmington Fibre Spec'ty Co.

Files
Nicholson File Co.

Filtering & Circulating System for Lubricating Oil
Bowser & Co., S. F.
Nugent & Co., W. W.
Richardson Phenix Co.
Wayne Oil Tank & Pump Co.

Filters, Feed Water
Blackburn-Smith Corp.
Griscom-Russell Co.

Filters, Oil
Anderson Co., V. D.
Blackburn-Smith Corp.
Bowser & Co., S. F., Inc.
Burt Mfg. Co.
Elliott Co.
Fitchburg Steam Engine Co.
Richardson-Phenix Co.
Robertson Co., John F.

Filters, Oil, Removal
Permutit Co.
Wayne Oil Tank & Pump Co.

Filters, Water
Blackburn-Smith Corp.
Elliott Co.
Griscom-Russell Co.
International Filter Co.
N. Y. Continental Jewell Filtration Co.
Permutit Co.

Fire Brick, Cement and Mortar
Betson Plastic Fire Brick Co.
Botfield Specialties Mfg. Co.
A. P. Green Fire Brick Co.
Hagan Corp., Pittsburgh
Johns Manville Co.
Jointless Fire Brick Co.
McLeod & Henry
Obermayer Co., The S.
Pitts & Kitts Mfg. & Supply Co.
Quigley Furnace Specialties Co.
Walsh Fire Clay Prod. Co.

Fire Extinguishers
Badger & Sons Co., E. B.
Johns-Manville

Firebox Blocks
A. P. Green Fire Brick Co.
McLeod & Henry Co.
Walsh Fire Clay Prod. Co.

Fittings, Ammonia
Carbondale Machine Co.
Greene, Tweed & Co.
York Mfg. Co.

Fittings, Oil Pipe Union Cinch
Richardson Phenix Co.

Fittings, Steel
Crane Co.
Edward Valve & Mfg. Co.
Nat'l Valve & Mfg. Co.
Pittsburgh Piping & Equip. Co.

Fixtures, Electrical
Adapti Co., The

Flanges
American Dist. Steam Co.
Dart Mfg. Co., E. M.
M. J. Dougherty Co.
Jefferson Union Co.
Jenkins Bros.
Kelly & Jones
Kennedy Valve Mfg. Co.
Nat'l Valve & Mfg. Co.
Pittsburgh Piping & Equip. Co.

Flashlights
National Carbon Co.

Flat Wire—Strip Steel
Am. Steel & Wire Co.

Floats
Anderson Co., V. D.
Hercules Float Works
Reliance Gauge Column Co.

Flow Meters
(See Meters, Flow)

Floor Gratings
Irving Iron Works

Flooring, Mastic and Cork Tile
Johns-Manville

Flue Cleaners
Chesterton Co., A. W.
Huyette & Co., Inc., Paul B.
Nat'l Flue Cleaner Co.

Forges
Buffalo Forge Co.

Forgings, Drop
Moore Drop Forging Co.
Williams & Co., J. H.

Forgings, Monel Metal
The International Nickel Co.

Fuel Oil Systems
Bowser & Co., S. F.

Furnace Blocks
Drake Non Clinkering Furnace Block Co.
McLeod & Henry
Walsh Fire Clay Prod. Co.

Furnace Door Arch
Betson Plastic Fire Brick Co.
Jointless Fire Brick Co.
McLeod & Henry Co.
Obermayer Co., The S.
Walsh Fire Clay Prod. Co.

Furnace, Heat Treating
Wayne Oil Tank & Pump Co.

Furnace Lining
Betson Plastic Fire Brick Co.
Botfield Specialties Mfg. Co.
A. P. Green Fire Brick Co
Jointless Fire Brick Co.
McLeod & Henry
Obermayer Co., The S.
Quigley Furnace Specialties Co.
Walsh Fire Clay Prod. Co.

Furnaces
Automatic Furnace Co.
Cokal Stoker Corporation
Detroit Stoker Company
Green Engineering Co.
Hagan Corporation, The
Hofft Co., M. A.
McClave Brooks Co.
Murphy Iron Works
Rust Engr. Co.
Sterling Blower Co.

Fuses
Chicago Fuse Co.
Economy Fuse & Mfg. Co.
Federal Sign System
General Electric Co.
Johns-Manville
Westinghouse Elec. & Mfg. Co.

Gage Boards
Ashton Valve Co.
Foxboro Co.
Precision Instrument Co.
Schaffer & Budenberg Mfg. Co., The

Gage Cocks
(See Cocks, Gage)

Gage Glasses
Advance Packing & Supply Co.
Chesterton Co., A. W.
Durabla Mfg. Co.
Garlock Packing Co.
Quaker City Rubber Co.

Gage Glass Guards and Shields
Durabla Mfg. Co.
Kelly & Jones
Paul B. Huyette Co., Inc.

Gage Glass Reflectors
Durabla Mfg. Co.

Gage Testing Outfit
Am. Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Schaeffer & Budenberg Mfg. Co.

Gages, Caliper
Williams & Co., J. H.

Gages, Differential
Brown Instrument Co.

Gages, Draft
Bristol Co.
Brown Instrument Co.
Defender Automatic Reg. Co
Dwight Mfg. Co.
Ellison, Lewis M.
Hays Corp., Jos. W.
Huyette & Co., Inc., Paul B.
Nat'l Flue Cleaner Co.
Pierce Co., Wm. B.

Gages, Hydraulic
Brown Instrument Co.

Gages, Oil
Richardson-Phenix Co.

Gages, Pressure
Am. Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Bristol Co.
Brown Instrument Co.
Crosby Steam Gage & Valve Co.
Schaeffer & Budenberg Mfg. Co., The
Taylor Instrument Cos.

Gages, Recording
Am. Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Bristol Co.
Brown Instrument Co.
Defender Automatic Ry. Co.
Foxboro Co.
Jos. W. Hays Corporation
McDonough Automatic Regulator Co.
Schaeffer & Budenberg Mfg. Co., The

Gages, Vacuum
Ashton Valve Co.
Bristol Co.
Greene, Tweed & Co.
Taylor Instrument Cos.

Gages, Water
American Dist. Steam Co.
Brown Instrument Co.
Crosby Steam Gage & Valve Co.
Greene, Tweed & Co.
Huyette Co., Inc., Paul B.
Jenkins Bros.
Lunkenheimer Co.
Nat'l Flue Cleaner Co.
Ohio Brass Co.
Penberthy Injector Co.
Reliance Gauge Column Co.

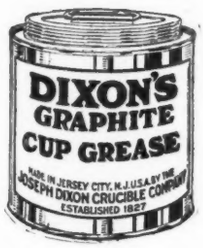
Gas Burners
Davidson Gas Burner & Welding Co., N. C.
Tate-Jones & Co. Inc.

Gas Exhausters
General Electric Co.
Ingersoll-Rand Co.
Sturtevant Co., B. F.
Terry Steam Turbine Co.

Gas Producers
Milwaukee Reliance Boiler Works

Welcome News from The Engine-Room!

Dixon's Cup Grease



The engineer has learned another lesson. Hereafter the Cup Grease for the various units in the plant will be DIXON'S.

Any good cup grease, plus a carefully determined percentage of selected flake graphite, will last longer and lubricate better than the same grease without graphite. The added durability and efficiency are due solely to the graphite.

Dixon's prepared Cup Greases can be used under conditions of heat, moisture and pressure where plain grease will fail.

The service records of Dixon's show great economy. If you are looking for a better grease let us send you a sample No. 94-R.

Made in JERSEY CITY, N. J., by the

Joseph Dixon Crucible Company

Established 1827

We also make

- ☐ Cup Grease
- ☐ Joint Compound
- ☐ Silica-Graphite Paint
- ☐ Waterproof Grease
- ☐ Flake Graphite
- ☐ Motor Brushes
- ☐ Solid Belt Dressing
- ☐ Paste Belt Dressing
- ☐ Boiler Graphite

Write for catalog. Mark X in square

Westinghouse Elec & Mfg. Co.
Worthington Pump & Mach. Corp.

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Advance Pkg. & Supply Co.
Akron Metallic Gasket Co.
Crane Co.
Diamond Rubber Co.
Durabla Mfg. Co.
Eureka Packing Co.
Flexitalic Gasket Co.
Garlock Packing Co.
Gen'l Asbestos & Rubber Co.
Goetze Gasket & Pkg. Co.
Goodrich Rubber Co., B. F.
Greene, Tweed & Co.
Jenkins Bros.
Johns-Manville
McCord Mfg. Co.
Metallo Gasket Co.
N. Y. Belting & Packing Co.
Quaker City Rubber Co.
Sarco Co.
Smooth-On Mfg. Co.
United States Rubber Co.
Wilcox Mfg. Co., E. A.

Gaskets, Asbestos
Dominion Asbestos & Rubber Co.
Gen'l Asbestos & Rubber Co.

Gaskets, Copper Rubber
E. A. Wilcox Mfg. Co.

Gaskets, Fibre
Wilmington Fibre Specialty Co.

Gaskets, Water Gage
Morse, R. F.

Gasoline Electric Generating Sets
Sturtevant Co., B. F.

Gasoline Storage System
Wayne Oil Tank & Pump Co.

Gates, Bin
Am. Steam Conveyor Corp.
Brown Hoisting Machy. Co.
R. H. Beaumont Co.
Green Engr. Co.
Jeffrey Mfg. Co.
Chain Belt Co.
Link-Belt Co.

Gates, Drainage
Armco Iron Culvert & Flume Mfrs. Assn.

Gates, Sluice
Chapman Valve Mfg. Co.

Gears
Chain Belt Co.
De Laval Steam Turbine Co.
Earle Gear & Machine Co.
General Electric Co.
Jeffrey Mfg. Co.
Link-Belt Co.
Moore Steam Turbine Corp
Poole Eng. & Mach. Co.

Generating Sets
General Electric Co.
Allis-Chalmers Mfg. Co.
Ridgway Dynamo & Eng. Co.
Sturtevant Co., B. F.
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.

Generator Coolers
American Spray Co.
Badger & Sons Co., E. B.
Ridgway Dynamo & Eng. Co.
Spray Engine Co.

Generators, Electric
Allis-Chalmers Mfg. Co.
General Electric Co.
Kerr Turbine Co.
Moore Steam Turbine Corp.
Ridgway Dynamo & Eng. Co.
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.

Governors, Pressure
Northern Equipment Co.
S.-C. Regulator Co.

Governors, Pump
Chaplin-Fulton Mfg. Co.
Davis Regulator Co., G. M.
Fisher Governor Co., Inc., The
Foster Engineering Co.
Illinois Engineering Co.
Marion Mch., Fdry. & Supply Co.
Mason Regulator Co.
McDonough Automatic Regulator Co.
Northern Equipment Co.
S.-C. Regulator Co.
Squires Co. C. E.
Strong, Carlisle & Hammond Co., The
Watson & McDaniel Co.
Webster & Co., Warren
Wright, Austin Co.

Graphite
Dixon Crucible Co., Jos.
Garlock Packing Co.
Greene, Tweed & Co.

Grate Bars
Botfield Specialties Mfg. Co
Cokal Stoker Corporation
McEwen Bros.
Valley Iron Works

Grates
Armstrong Mfg. Co.
Automatic Furnace Co., The
Babcock & Wilcox Co., The
Budd Grate Bar Co.
Combustion Eng. Corp.
Cyclone Grate Bar Co.
Flynn & Emrich
Green Engineering Co
Hofft, M. A., Co.
Hulson Grate Co.
International Engineering Works
Kelly Fdry. & Mch. Co.
Marion Mch., Fdry. & Supply Co.
McClave-Brooks Co.
McEwen Bros.
Neemes Bros.
Power Turbo Blower Co.
Springfield Boiler Co.
Valley Iron Works
Washburn & Granger, Inc.

Grating, Flooring and Subway
Irving Iron Works
Washburn & Granger, Inc.

Grease
Albany Lubricating Co.
Dearborn Chemical Co.
Dixon Crucible Co., Jos.
Keystone Lubricating Co.
N. Y.-N. J. Lubricant Co.
Ohio Grease Co.
Texas Company

Grease Cups (Compressed Air)

Grease Extractors
Am. Steam Gage & Valve Mfg. Co.
Blackburn-Smith Corp.
Elliott Co.
Griscom-Russell Co.
Lagonda Mfg. Co.

Grease Guns
Bowser & Co., S. F.

Hand Pumps for Oil & Gasoline
Bowser & Co., S. F.

Hangers, Shafting
Chain Belt Co.
Chas. P. Bond Co.
Cresson-Morris Co.
Hyatt Roller Bearing Corp.
Jeffrey Mfg. Co.
Link-Belt Co.
Valley Iron Works

Heaters, Domestic
Alberger Heater Co.
Patterson Kelley Co.
Ross Heater & Mfg. Co.

Heaters, Feed Water
(See Feed Water Heaters)

Heating and Ventilating Systems
Buffalo Forge Co.
Illinois Engineering Co.
Whitlock Coil Pipe Co.
Webster & Co., Warren

High Pressure Blowers
(See Blowers, Forced Draft)

Hoist Hooks
Williams & Co., J. H.

Hoists
Fairbanks-Morse
Gillis & Geoghegan
Godfrey Conveyor

Hoists, Air
Ingersoll-Rand Co.
Nordberg Mfg. Co.

Hoists, Electric
Beaumont Co., R. H.
Brown Hoisting Mach. Co.
Gillis & Geoghegan
Link-Belt Co.
Nordberg Mfg. Co.
Shepard Elec. Crane & Hoist Co.

Hoists, Steam
Nordberg Mfg. Co.
Sullivan Machinery Co.

Hoppers, Coal and Ash
Beaumont Co., R. H.
Brown Hoisting Mchy. Co.
Green Engineering Co.
Jeffrey Mfg. Co.
Link-Belt Co.

Hose, Rubber
Goodrich Rubber Co., B. F.
Goodyear Tire & Rubber Co.
N. Y. Belting & Pkg. Co.
Pioneer Rubber Mills
Quaker City Rubber Co.
United States Rubber Co.

Hydrants
Kennedy Valve Mfg. Co.

Hydrodeiks
Taylor Instrument Cos.

Hydrometers and Hygrometers
Brown Instrument Co.
Taylor Instrument Cos.

Ice Machine Repairs
Underwood & Co., H. B.

Ice Making Machinery
Norwalk Iron Wks.
York Mfg. Co.

Ice and Refrigerating Machinery. (See Refrigerating Machinery)

Incinerators
Washburn & Granger, Inc.

Indicators, Ammonia
American Steam Gauge & Valve Mfg. Co.
Trill Indicator Co.

Indicators, Draft
Brown Instrument Co.

Indicators, Flow
Richardson-Phenix Co.

Indicators, Speed
Biddle, James C.
Brown Instrument Co.
Starrett Co., L. S.

Indicators, Steam Engine
American Steam Gauge & Valve Mfg. Co.
Crosby Steam Gage & Valve Co.
Robertson & Sons, Jas. L.
Trill Indicator Co.

Injectors
American Injector Co.
Jenkins Bros.
Lunkenheimer Co.
Penberthy Injector Co.
Powell Co., Wm.
Schutte & Koerting Co.
Sherwood Mfg. Co.

Instruments, Electrical Measuring
Weston Elec. Inst. Co.

Kerosene Pumps & Tanks
Bowser & Co., S. F.

Ladder Treads, Non-Slipping
Irving Iron Works

Lamps, Arc
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Incandescent
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lathe Dogs, Safety
Williams & Co., J. H.

Lathes, Foot Power
Barnes Co., W. F. & John

Leathers, Hydraulic and Cup
Schieren Co., Chas. A.

Leather Lace
Schieren Co., Chas. A.

Lubricators, Cylinder
Greene, Tweed & Co.
Hills-McCanna Co.
Keystone Lubricating Co.
Lunkenheimer Co.
McCord Mfg. Co.
McCullough Mfg. Co.
Manzel Bros. Co.
Michigan Lubricator Co.
Ohio Grease Co.
Powell Co., Wm.
Richardson-Phenix Co.

Lubricators, Force Feed
Greene, Tweed & Co.
Lunkenheimer Co.
McCord Mfg. Co.
McCullough Mfg. Co.
Manzel Bros. Co.
Powell Co., Wm.
Richardson-Phenix Co.

Lubricators, Graphite
Farnsworth Company
Richardson-Phenix Co.

Lubricating Oil Filtering, Tanks and Pumps
Bowser & Co., S. F.
Richardson-Phenix Co.
Wayne Oil Tank & Pump Co.

Machine Tools
The Fairbanks Co.

Machine Works, Special
Griscom-Russell Co.
Lammert & Mann
Link-Belt Co.

Machinists' Tools
Williams & Co., J. H.

Mats and Matting
Goodyear Tire & Rubber Co.
N. Y. Belting & Packing Co.

Metal, Bearing
Allan & Son, A.
Magnolia Metal Co.

Meters, Air
Bailey Meter Co.
Builders Iron Foundry
General Electric Co.
Republic Flow Meters Co.

Meters, Coal
Havard Co., O. D.

Meters, Electrical Measuring
Weston Elec. Inst. Co.

Meters, Feed Water
Webster & Co., Warren
Worthington Pump & Machy. Corp.
Yarnall-Waring Co.

Meters, Flow
Hagan Corporation, The
Republic Flow Meters Co.
Yarnall-Waring Co.

Meters, Gas
Bailey Meter Co.
Builders Iron Foundry
General Electric Co.
Republic Flow Meters Co.

Meters, Heat
Brown Instrument Co.

Meters for Oil, Kerosene & Gasoline
Bowser & Co., S. F.
Wayne Oil Tank & Pump Co.

Meters, Oil
Bailey Meter Co.
Builders Iron Foundry
General Electric Co.
Republic Flow Meters Co.
Richardson-Phenix Co.
Worthington Pump & Mch. Corp.

Meters, Steam
American Dist. Steam Co.
Bailey Meter Co.
Builders Iron Foundry
General Electric Co.
Republic Flow Meters Co.

Meters, Water
Alberger Pump & Condenser Co.
American Dist. Steam Co.
Bailey Meter Co.
Builders Iron Foundry
General Electric Co.
H. S. B. W. Cochrane Corp. (Formerly Harrison Safety Boiler Works)
Hoppes Mfg. Co.
Republic Flow Meters Co.
Richardson Scale Co.
Worthington Pump & Mch. Corp.
Yarnell-Waring Co.

Micrometers
Starrett Co., L. S.

Milli-Ammeters
Brown Instrument Co.

Milli-Voltmeters
Brown Instrument Co.

Mill, Mining & Railway Supplies
The Fairbanks Co.
The Mine & Smelter Supply Co.

Motors, Electric
Allis-Chalmers Mfg. Co.
Crocker-Wheeler Co.
Fairbanks-Morse Co.
General Electric Co.
Ridgway Dynamo & Engine Co.
Westinghouse Elec. & Mfg. Co.

Motors, Water
Roto Co.

Multiwhirl Oil Cooler
Griscom-Russell Co.

Oil and Grease Cups
Albany Lubricating Co.
American Injector Co.
Keystone Lubricating Co.
Lunkenheimer Co.
Ohio Grease Co.
Penberthy Injector Co.
Powell Co., Wm.
Richardson-Phenix Co.

Oil Burners
Davidson Gas Burner & Welding Co., N. C.
Hammel Oil Burning Equipment Co., Inc.
Schutte & Koerting
Tate-Jones & Co., Inc.
Wayne Oil Tank & Pump Co.

Oil Coolers
Alberger Heater Co.
Griscom-Russell Co.
Schutte & Koerting Co.

Oil Pumps, Sets
The Hammel Oil Burner Co.

Oil Purifiers
Richardson-Phenix Co.
Robertson Co., John F.

Oil Reservoirs
Bowser & Co., S. F.
Burt Mfg. Co.
Coatesville Boiler Wks.
Elliott Co.
Lancaster Iron Works
McEwen Bros.
Richardson-Phenix Co.

Oil Separators
(See Separators, Oil)

Oil Strainers
Griscom-Russell Co.

Oiling Devices and Systems
Bowser & Co., S. F.
Burt Mfg. Co.
Elliott Co.
Lunkenheimer Co.
McCord Mfg. Co.
McCullough Mfg. Co.
Michigan Lubricator Co.
Richardson-Phenix Co.
Sherwood Mfg. Co.
Wayne Oil Tank & Pump Co.

Oil Testing Instruments
Tagliabue Mfg. Co.

Oil Well Supplies
McEwen Bros.

Oils
Albany Lubricating Co.
Carpenter Co., Geo. B.
Dearborn Chemical Co.
N. Y.-N. J. Lubricant Co.
Texas Company

Packing, Asbestos
Advance Pkg. & Supply Co.
Carpenter Co., Geo. B.
Chesterton Co., A. W.
Dominion Asbestos & Rubber Co.
Durabla Mfg. Co.
General Asbestos & Rubber Co.
Johns-Manville
Johns-Pratt Co.
N. Y. Belting & Packing Co.
Sarco Co.

Packing, Cylinder
General Asbestos & Rubber
N. Y. Belting & Pkg. Co.
Rooksby & Co., E. J.

Packing, Flax
Chesterton Co., A. W.
General Asbestos & Rubber Co.
Johns-Manville

Packing, Flexible Metallic
Crane Packing Co.

Packing, Hydraulic
Advance Packing & Supply Co.
Chesterton Co., A. W.
Crane Packing Co.
Eureka Packing Co.
Garlock Packing Co.
General Asbestos & Rubber Co.
Goetze Gasket & Pkg. Co.
Goodrich Rubber Co., B. F.
Goodyear Tire & Rubber Co.
Johns-Manville
N. Y. Belting & Packing Co.
Quaker City Rubber Co.
Schieren Co., Charles A.
United States Rubber Co.
Walker & Co., Ltd., Jas.

Packing, Leather
Schieren Co., Charles A.

Packing, Metallic
Am. Huhn Metallic Pkg. Co.
American Steam Packing Co.
Crane Packing Co.
Eureka Packing Co.
Garlock Packing Co.
Merrill & Co., Wm. B.
N. Y. Belting & Packing Co.
Steel Mill Packing Co.
Tripp Metallic Packing Co.
Walker & Co. Ltd., Jas

Packing, Oil
Crane Packing Co

Packing, Piston
Chesterton Co., A. W.
Crane Packing Co.
General Asbestos & Rubber Co.
Goodrich Rubber Co., B. F.
Johns-Manville
N. Y. Belting & Packing Co.
United States Rubber Co.

Packing, Pump Valve
Garlock Packing Co.
Goodrich Rubber Co., B. F.
Johns-Manville
N. Y. Belting & Packing Co.
Quaker City Rubber Co.
United States Rubber Co.

Packing, Rod
American Steam Packing Co.
Chesteron Co., A. W.
Crane Packing Co.
Dominion Asbestos & Rubber Co.
Durabla Mfg. Co.
Eureka Packing Co.
Garlock Packing Co.
General Asbestos & Rubber Co.
Goetze Gasket & Pkg. Co.
Goodrich Rubber Co., B. F.
Goodyear Tire & Rubber Co.
Greene, Tweed & Co.
Johns-Manville
Merrill & Co., Wm. B.
N. Y. Belting & Packing Co.
Pioneer Rubber Mills
Quaker City Rubber Co.
Steel Mill Packing Co.
United States Rubber Co.
Westinghouse Elec. & Mfg. Co.

Packing Sheet
Advance Pkg. & Supply Co.
Am. Huhn Metallic Pkg. Co.
Dominion Asbestos & Rubber Co.
Durabla Mfg. Co.
Eureka Packing Co.
Garlock Packing Co.
General Asbestos & Rubber Co.
Goodrich Rubber Co., B. F.
Goodyear Tire & Rubber Co.
Greene, Tweed & Co.
Jenkins Bros.
Johns-Manville
Johns-Pratt Co.
McCord Mfg. Co.
N. Y. Belting & Packing Co.
Pioneer Rubber Works
Quaker City Rubber Co.
Walker & Co., Ltd., Jas.

Packing, Valve Stem
Crane Packing Co.
Eureka Packing Co.
Garlock Packing Co.
General Asbestos & Rubber Co.
Greene, Tweed & Co.
Johns-Manville
McCord Mfg. Co.
N. Y. Belting & Packing Co.
Quaker City Rubber Co.
Steel Mill Pkg. Co.
United States Rubber Co.

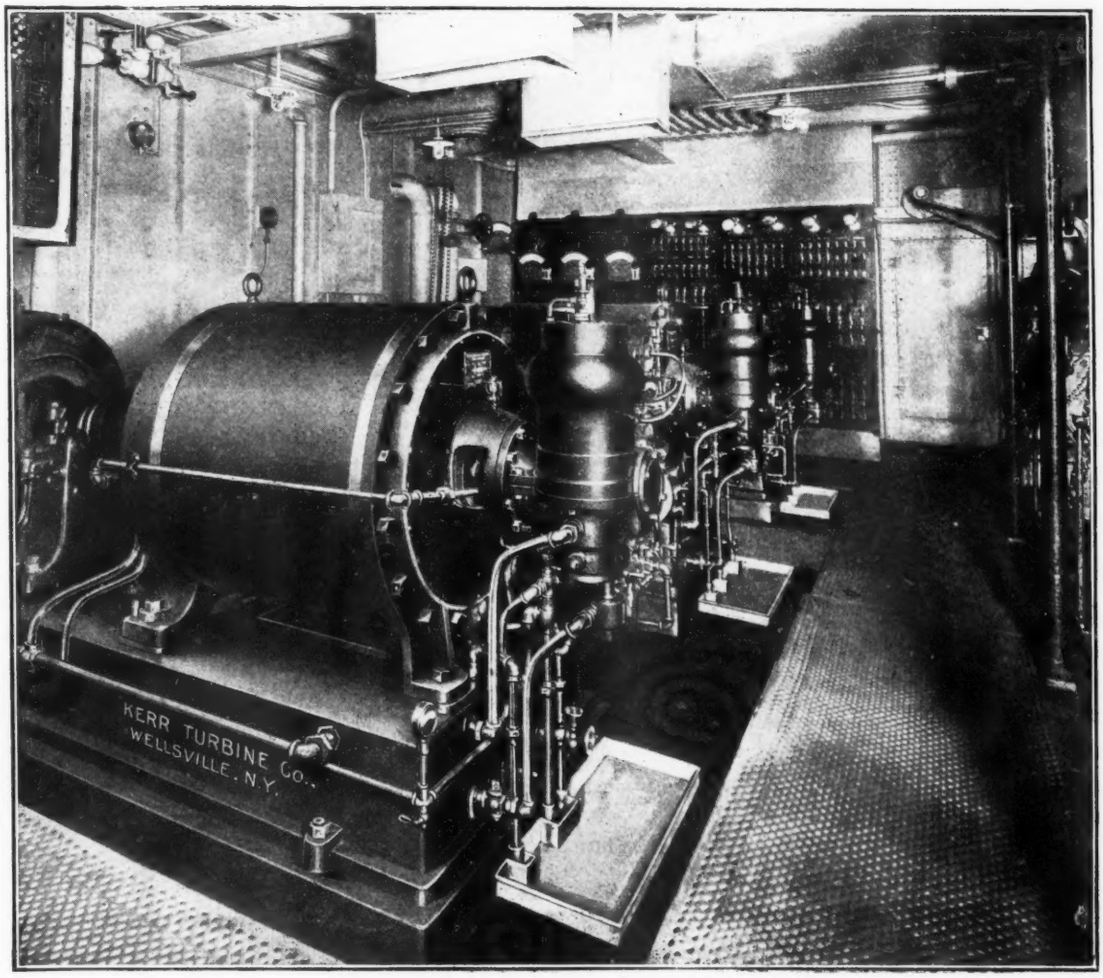
Paint, Cold Water
Johns-Manville

Paint, Graphite
Dixon Crucible Co., Jos.

Paint, Metal
Durabla Mfg. Co.

Paint, Smoke Stack
Dixon Crucible Co., Jos.

Pipe
Armco Iron Culvert & Flume Mfrs. Ass'n
Byers Co., A. M.
Carpenter Co., Geo. B.



"Their Seventh Season and Running Without a Hitch"

THAT is the way the Chief Engineer of the Great Lakes Steamer "SEEANDBEE" summed up his report on the performance of these Kerr Turbines. As that report was made last July, *this* season will be the *eighth* for these three 75-kw., D.C. "ECONOMY" Turbo-Generator Sets to light the nights on the Great Lakes for travelers plying between Cleveland and Buffalo.

The "SEEANDBEE" is the largest steamer of the C. & B. Line—in fact the largest steamer in the world on inland waters. No expense was spared in giving her the best of equipment throughout.

So the selection of "ECONOMY" Turbines in preference to others was a natural thing to expect from her builders. They chose "ECONOMY" Turbines not only because their purchase price, installation, and performance are based upon bed-rock economy, but because *absolute reliability* was considered the *first requisite of real economy.*

There need never be any doubt about Kerr "ECONOMY" Turbines living up to their name: Everywhere are they known for economical performance—*continuity of service with low operating cost.*

The Kerr Catalog will give you valuable information. May we mail it to you?

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Boston, Mass., 79 Milk St.
Charlotte, N. C., Realty Bldg.
Chicago, Ill., Marquette Bldg.
Cincinnati, O., Mercantile Library.
Cleveland, O., 1900 Euclid Ave.
Dallas, Tex., Southwestern Life Bldg.
Detroit, Mich., Kerr Machinery Bldg.
Duluth, Minn., Lyceum Bldg.
Indianapolis, Ind., State Life Bldg.
New Orleans, La., 305 Magazine St.
New York, N. Y., 30 Church St.
Philadelphia, Pa., Stock Ex. Bldg.
Pittsburgh, Pa., Oliver Bldg.
Portland, Ore., Lewis Bldg.
San Francisco, Cal., Sharon Bldg.
Seattle, Wash., L. C. Smith Bldg.
St. Louis, Mo., Boatman's Bank Bldg.
Montreal, Canada, Southam Bldg.
Toronto, Canada.
Winnipeg, Canada, 207 Scott Block.
London, England, 11 Carteret St.
Honolulu, T. H.
Shanghai, China.
Tokio, Japan.

KERR TURBINES

M. J. Dougherty Co.
Kellogg Co., M. W.
National Tube Co.
Power Piping Co.
Whitlock Coil Pipe Co.

Pipe Bending
Am. Pipe Bending Mach. Co.
M. J. Dougherty Co.
Kellogg Co., M. W.
National Pipe Bending Co.
Nat'l Valve & Mfg. Co.
Pittsburgh Piping & Equip. Co.
Whitlock Coil Pipe Co.

Pipe Bends
American Tube & Pipe Bending Co.

Pipe, Bent and Coiled
M. J. Dougherty Co.
Whitlock Coil Pipe Co.

Pipe Coils
Abendroth & Root Mfg. Co.
M. J. Dougherty Co.
Locomotive Superheater Co.
National Pipe Bending Co.
Nat'l Valve & Mfg. Co.
Whitlock Coil Pipe Co.

Pipe Cutting and Threading Machines
Armstrong Mfg. Co.
Borden Co., The
Curtis & Curtis Co.
Toledo Pipe Threading Mach. Co.
Trimont Mfg. Co.

Pipe Fittings
American Dist. Steam Co.
M. J. Dougherty Co.
Jefferson Union Co.
Nat'l Valve & Mfg. Co.
Pittsburgh Piping & Equip. Co.
Walworth Mfg. Co.

Pipe Headers, Welded
M. J. Dougherty Co.

Pipe Joint Compound
Dixon Crucible Co., Jos.

Pipe, Welded and Seamless
National Tube Co.

Pipe, Wood
American Dist. Steam Co.

Piping Contractors
Pittsburgh Piping & Equip. Co.
National Valve & Mfg. Co.

Piping Fabricators
National Valve & Mfg. Co.
Pittsburgh Piping & Equip. Co.

Piping, High Pressure
A. M. Beyers Co.
Crane Co.
M. J. Dougherty Co.
National Tube Co.
Nat'l Valve Mfg. Co.
Pittsburgh Piping & Equip. Co.

Pipe, Wrought Iron
Byers Co., A. M.

Pipe Wrought Steel
National Tube Co.

Planimeters
American Steam Gauge & Valve Mfg. Co.
Robertson & Sons, Jas. L.
Trill Indicator Co.

Plumbago
Dixon Crucible Co., Jos.

Plumbers' Tools
Williams & Co., J. H.

Pneumatic Tools
Ingersoll-Rand Co.

Poles, Tubular Steel
National Tube Co.

Primers, Pump
Schutte & Koerting Co.

Pulleys
American Pulley Co.
Bond Co., Chas. P.
Caldwell, W. E. Co., Inc.
Cresson-Morris Co.
Greene, Tweed & Co.
Jeffrey Mfg. Co.
Link-Belt Co.
Saginaw Mfg. Co.
Valley Iron Works

Pulverized Fuel, Equipment
The Bonnot Company
Fuller Lehigh Co.
Jeffrey Mfg. Co.
Pulverized Fuel Co.
Quigley Furnace Specialties Co.
Williams Patent Crusher & Pulverizer Co.
Worthington Pump & Mach. Corp.

Pumps, Acid
Trimont Rotary Power Co.
Lea-Courtenay Co., The
Davidson Co., M. T.
Worthington Pump & Mach. Corp.

Pumps, Air
Alberger Pump & Condenser Co.
Croll-Reynolds
Davidson Co., M. T.
Manistee Iron Works
The Mine & Smelter Supply Co.
Norwalk Iron Wks.
Schutte & Koerting Co.
Wheeler Condenser & Engr. Co.
Wheeler Mfg. Co., C. H.
Worthington Pump & Mach. Corp.

Pumps, Boiler Feed
Cameron Co., A. S.
Coppus Engr. & Equip. Co.
Dayton Dowd Co.
Dean Bros. Steam Pump Wks.
Earle Gear & Machine Co.
Farnsworth Company
Lea-Courtenay Co., The
Manistee Iron Works
Morris Machine Wks.
Platt Iron Works
Pratt & Cady Co., Inc.
Traylor Engr. & Mfg. Co.

Pumps, Brine
Cameron Co., A. S.
Lea-Courtenay Co., The
Pratt & Cady Co., Inc.

Pumps, Centrifugal
Alberger Pump & Condenser Co.
Allis-Chalmers Mfg. Co.
American Well Works
Buffalo Steam Pump Co.
Cameron Steam Pump Wks., A. S.
Coppus Engr. & Equip. Co.
Dayton-Dowd Co.
De Laval Steam Turbine Co.
Earle Gear & Machine Co.
Fairbanks Morse & Co.
Frederick Iron & Steel Co.
Lea-Courtenay Co.
Manistee Iron Works
Midwest Engine Co.
Morris Machine Works
Pennsylvania Pump & Compressor Co.
Goulds Mfg. Co.
Pratt & Cady Co., Inc.
Taber Pump Co.
Terry Steam Turbine Co.
Twinvolute Pump & Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Wheeler Condenser & Engr. Co.
Wheeler Mfg. Co., C. H.
Worthington Pump & Mach. Corp.

Pump, Compression, Gas
Norwalk Iron Wks.

Pumps, Condenser
A. S. Cameron Co.
Davidson Co., M. T.
Farnsworth Company
Lea-Courtenay Co.
Manistee Iron Works
Pratt & Cady Co., Inc.

Pumps, Deep Well
American Well Works
Cameron Co., A. S.
Davidson Co., M. T.
Morris Machine Works
Weber Subterranean Pump Co.
Worthington Pump & Mach. Corp.

Pumps, Fire
Lea-Courtenay Co.

Pumps, Force Feed (See Lubricators)

Pumps, Elevator
Cameron Co., A. S.
Davidson Co., M. T.

Pumps, Grease
Richardson-Phenix Co.

Pumps, Irrigation and Drainage
Lea-Courtenay Co.

Pumps, Jet
Worthington Pump & Mach. Corp.

Pumps, Mine
Cameron Co., A. S.
Lea-Courtenay Co.
Pratt & Cady Co., Inc.

Pumps, Natural Gas
Norwalk Iron Wks.

Pump Liners, Monel Metal
The International Nickel Co.

Pumps, Oil
Bowser & Co., S. F.
Cameron Co., A. S.
McCullough Mfg. Co.
Manistee Iron Works
Nugent & Co., W. W.
Pratt & Cady Co., Inc.
Sherwood Mfg. Co.
Wayne Oil Tank & Pump Co.
Worthington Pump & Mach. Corp.

Pumps, Rotary
Taber Pump Co.
Lea-Courtenay Co.

Pumps, Self Measuring
Wayne Oil Tank & Pump Co.

Pumps, Steam
Buffalo Steam Pump Co.
Davidson Co., M. T.
Dean Bros., Steam Pump Wks.
Fairbanks, Morse & Co.
McGowan Co., The John H.
Morris Machine Works
Pennsylvania Pump & Compressor Co.
Pratt & Cady Co., Inc.
Terry Steam Turbine Co.
Wheeler Condenser & Engr. Co.
Worthington Pump & Mach. Corp.

Pumps, Turbine
Alberger Pump & Condenser Co.
Allis-Chalmers Co.
Buffalo Steam Pump Co.
Cameron Co., A. S.
Kerr Turbine Co.
Manistee Iron Works
Morris Machine Wks.

Pumps, Vacuum
Alberger Pump & Condenser Co.
American Well Works
Buffalo Steam Pump Co.
Cameron Co., A. S.
Croll-Reynolds
Davidson Co., M. T.
Dean Bros. Steam Pump Wks.
Goulds Mfg. Co.
Ingersoll-Rand Co.
Pratt & Cady Co., Inc.
Schutte & Koerting Co.
Trimont Rotary Power Co.
Westinghouse Elec. & Mfg. Co.
Wheeler Mfg. Co.
Wheeler Condenser & Engr. Co.
Worthington Pump & Mach. Corp.

Pumps, Water-Works
Allis-Chalmers Mfg. Co.
American Well Works
Cameron Co., A. S.
Earle Gear & Machine Co.
Lea-Courtenay Co., The
Midwest Engine Co.
Morris Machine Wks.
Pratt & Cady Co., Inc.
Terry Steam Turbine Co.
Worthington Pump & Mach. Corp.

Pyrometers
Bristol Co.
Brown Instrument Co.
Defender Automatic Regulator Co.
The Jos. W. Hays Corp.
Taylor Instrument Co.
Thwing Instrument Co.

Pyrometers, Electric Automatic
Brown Instrument Co.

Pyrometers, Electric Temperature
Brown Instrument Co.

Pyrometers, Controlling, for Electric, Gas or Oil Furnaces
Brown Instrument Co.

Pyrometers, Electric Indicating
Brown Instrument Co.

Pyrometers,- Electric Temperature Signalling
Brown Instrument Co.

Pyrometers, Electric Recording
Brown Instrument Co.

Pyrometers, Recording
Brown Instrument Co.
Hays Corp., Jos. W.
Taylor Instrument Co.
Thwing Instrument Co.

Rawhide Rope
Chas. A. Schieren Co.

Refrigerating Machinery
Carbondale Machine Co.
De Le Vergne Machine Co.
Johns-Manville
Norwalk Iron Wks.
Vilter Mfg. Co.
Vogt Mach. Co., Inc.
York Mfg. Co.

Regulators, Damper
American Dist. Steam Co.
Coppus Engr. & Equip. Co.
Davis Regulator Co., G. M.
Defender Automatic Regulator Co.
Mason Regulator Co.
McDonough Automatic Regulator Co.
Power Turbo Blower Co.
Robertson & Sons, James L.
Ruggles-Klingemann Mfg. Co.
Webster & Co., Warren
Wing Mfg. Co., L. J.

Regulators, Feed Water (See Feed Water Regulators)

Regulators, Pressure
Brown Instrument Co.
Chaplin-Fulton Mfg. Co.
Crane Co.
Davis Regulator Co., G. M.
D'Este Co., Julian
Elliott Co.
Engineer Co., The
Fisher Governor Co.
Illinois Engineering Co.
Mason Regulator Co.
Ohio Brass Co.
Squires & Co., C. E.
Strong, Carlisle & Hammond Co.
Tagliabue Mfg. Co.
Taylor Instrument Co.
Watson & McDaniel Co.

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Chaplin-Fulton Mfg. Co.
Davis Regulator Co., G. M.
D'Este Co., Julian
Foster Engineering Co
McDonough Automatic Regulator Co.
Northern Equipment Co.
S. C. Regulator Co
Squires & Co., C. E.
Strong, Carlisle & Hammond Co.
Washington Co.
Wilson Machinery Co., H. R.

Regulators, Temperature
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Brown Instrument Co.
Foxboro Co.
Sarco Company, Inc.
Tagliabue Mfg. Co.
Taylor Instrument Co.

Revolution Counters
Ashton Valve Co.
Brown Instrument Co.
Starrett Co., L. S.

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General Electric Co.
Westinghouse Elec. & Mfg. Co.

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Ingersoll-Rand Co.

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Williams & Co., J. H.

Rods, Monel Metal
The International Nickel Co.

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Johns-Manville

Rope
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Waterbury Co.

Rope Dressing
Cling Surface Co.

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American Steel & Wire Co.
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Irving Iron Wks.

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Chesterton Co., A. W.
General Specialty Co.
Lagonda Mfg. Co.
Liberty Mfg. Co.
Pierce Co., Wm. B.
Pilley Pkg. & Flue Brush Mfg. Co.
Robertson & Son, Jos. L.
The Roto Co.

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Brady Foundry Co., James A.
Reliance Weighing Machine Co.
Richardson Scale Co.

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Fairbanks, Morse & Co.
The Fairbanks Co.

Screens, Shaking and Revolving
Gifford-Wood Co.
Jeffrey Mfg. Co.
Link-Belt Co.

Screens, Water Intake
Chain Belt Co.
Link-Belt Co.

Screws, Monel Metal
The International Nickel Co.

Seamless Steel Tubing
National Tube Co.

Second-Hand Equipment (See Searchlight Section)

Separators, Ammonia
Carbondale Machine Co.
Elliott Co.
Strong, Carlisle & Hammond Co.
York Mfg. Co.

Separators, Oil
Allentown Experimental Works
American District Steam Co.
Anderson Co., V. D.
Crane Co.
Director Separator Co.
Edward Valve & Mfg. Co.
Elliott Co.
Griscom-Russell Co.
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Hoppes Mfg. Co.
Illinois Engineering Co.
Nashua Machine Co.
National Pipe Bending Co.
Ohio Body & Blower Co.
Robertson & Sons, Jas. L.
Schutte & Koerting Co.
Strong, Carlisle & Hammond Co., The
Webster & Co., Warren
Wright-Austin Co.

Separators, Steam
American District Steam Co.
Crane Co.
Direct Separator Co.
Edward Valve & Mfg. Co.
Elliott Co.
Griscom-Russell Co.
H. S. B. W. Cochrane Corp. (Formerly Harrison Safety Boiler Works)
Hoppes Mfg. Co.
Illinois Engineering Co.
Nashua Machine Co.
W. H. Nicholson & Co.
Ohio Body & Blower Co.
Patterson & Kelley Co., Inc.
James L. Robertson & Sons
Schutte & Koerting Co.
Strong, Carlisle & Hammond Co., The
Webster & Co., Warren
Whitlock Coil Pipe Co.
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Sewage Ejectors
Blackburn Smith Corp.

Shafting
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Richardson-Phenix Co.

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Burt Mfg. Co.

Sling Psychrometers
Taylor Instrument Cos.

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Williams & Co., J. H.

Soot Cleaners (See Blowers, Soot)

Soot Scrapers
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Spray Nozzles (See Cooling Plants and Ponds)

Springs
American Steel & Wire Co.

Stacks
Heine Safety Boiler Works
E. Keeler Co.
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Stack, Tank and Grate Work
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Stack Lining, Vitribestos
Johns-Manville

Stair Tread, Non-Slipping
Irving Iron Works

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Sturtevant Co., B. F.

Steam Eliminators
W. H. Nicholson & Co.

Steam Traps (See Traps)

Steam Turbines (See Turbines)

Steam Turbine Electric Generating Sets
Sturtevant Co., B. F.

Steel Plate Work
Heine Safety Boiler Works

Steel Plate Work
Lancaster Iron Works

Stocks and Dies
Borden Co., The

Stokers, Anthracite
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Fuller Lehigh Co.

Stokers, Chain Grate
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Files Engr. Co.
Flynn & Emrich
Hofft Co., M. A., The
McClave-Brooks Co.
Valley Iron Works
Vasil Steam Systems Co.

Stokers, Underfeed
American Engineering Co.
Brady Fdry. Co., James A.
Cokal Stoker Corporation
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Detroit Stoker Company
Fuller Lehigh Co.
M. A. Hoffit Co.
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Murphy Iron Works
Riley Stoker Co., Stanford
J. H. Roach & Co.
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Richardson-Phenix Co.

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Elliott Co.
Newman Mfg. Co.
Webster & Co., Warren

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American Injector Co.
Badger & Sons Co., E. B.
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Westinghouse Elec. & Mfg. Co.

Switches, Electric
General Electric Co.
Westinghouse Elec. & Mfg Co.

Swivels, Hook
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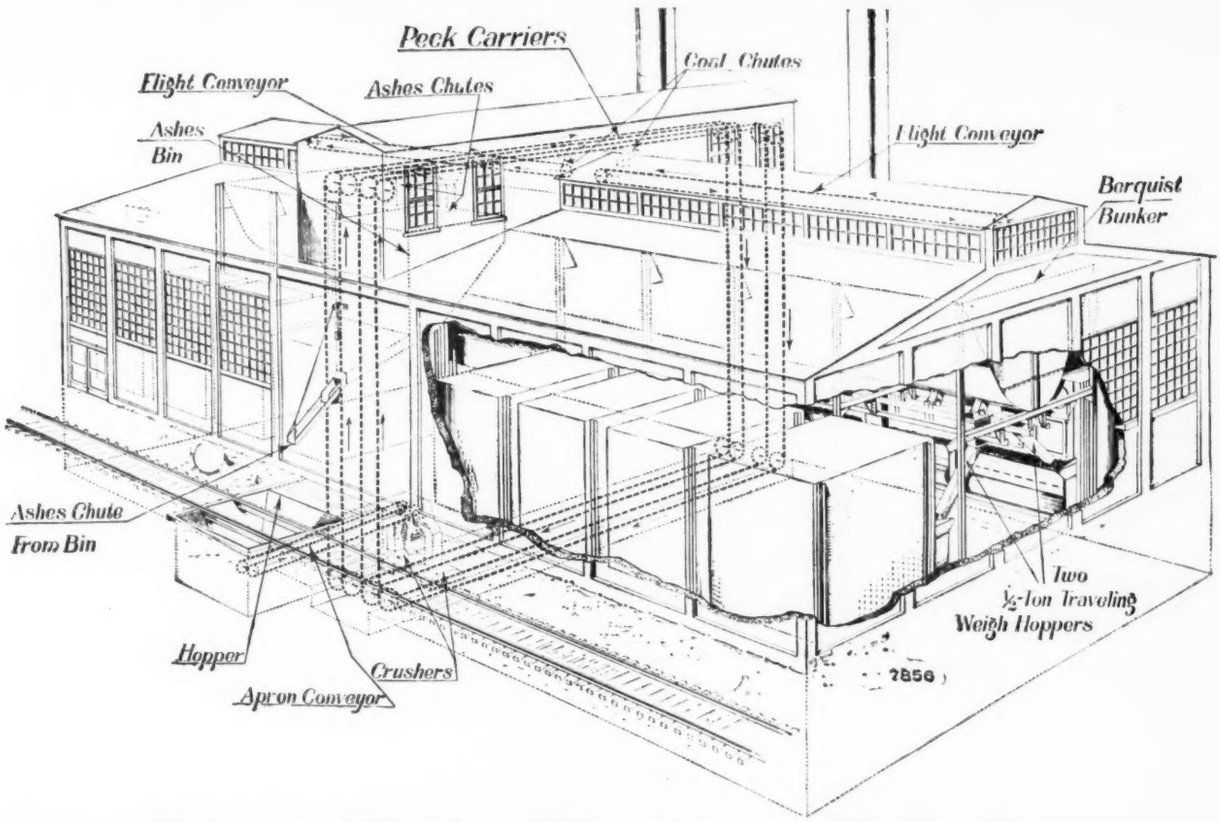

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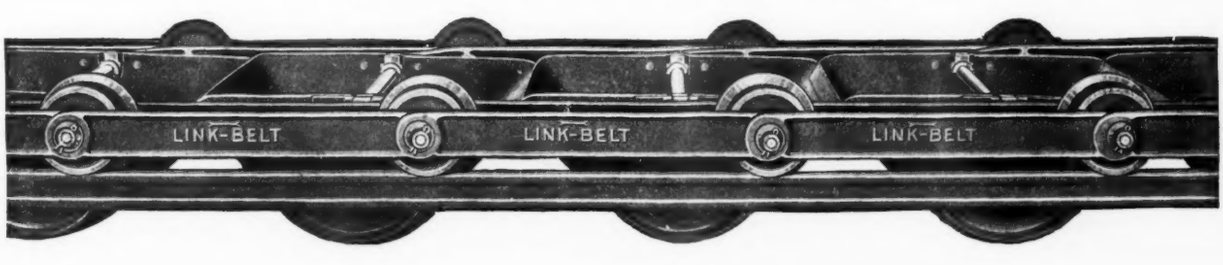

Tachometers
Biddle, James G.
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Lunkenheimer Co.
Nelson Valve Co.
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Homestead Valve Mfg. Co.
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Illinois Engineering Co.
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Defender Automatic Regulators Co.
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Mason Regulating Co.
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Squires Co., C. E.

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American Steam Gauge & Valve Mfg. Co.
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Crosby Steam Gage & Valve Co.
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Kunkle Valve Co.
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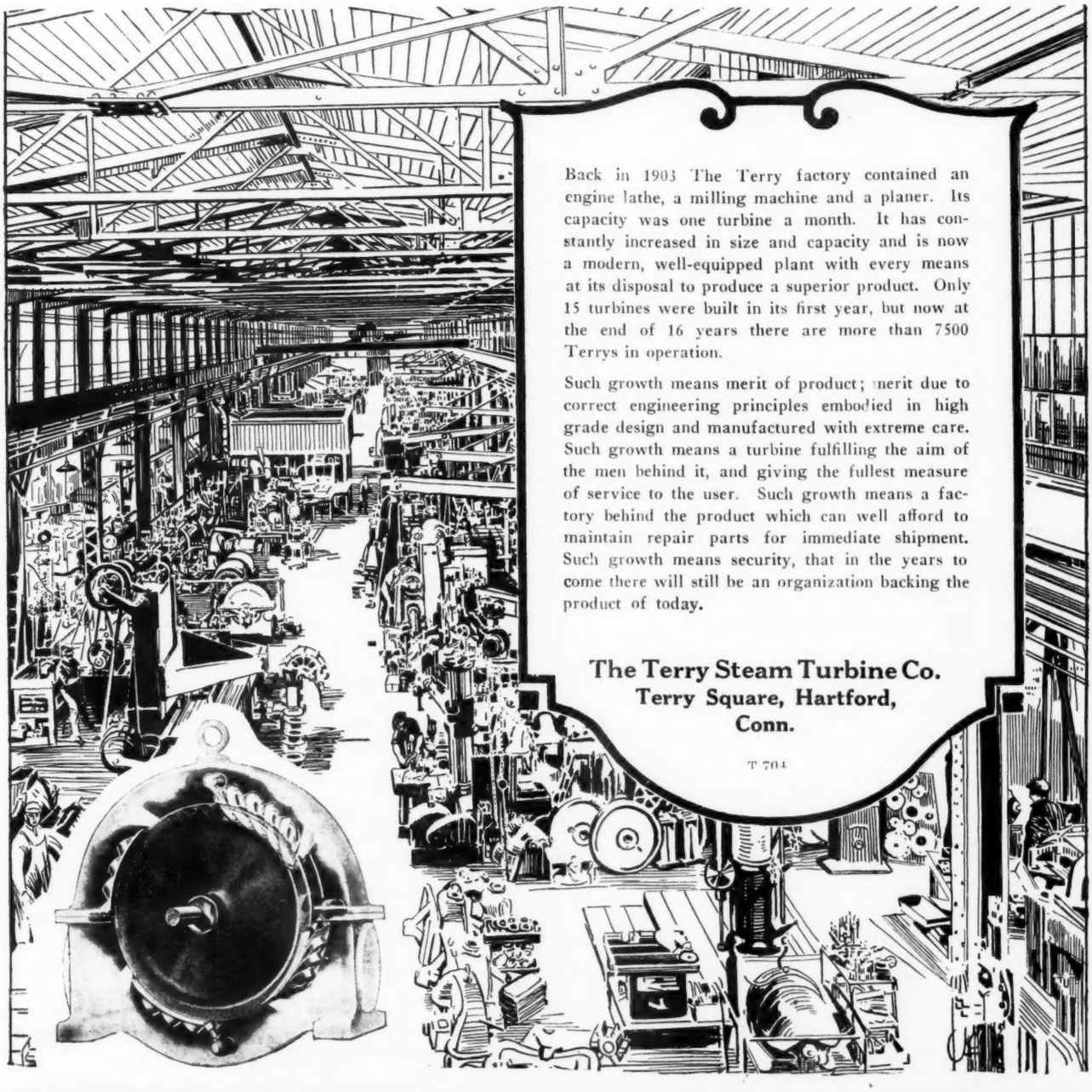
is only the name of a product, but behind it lie the important elements of value which only years of experience can produce.



Back in 1903 The Terry factory contained an engine lathe, a milling machine and a planer. Its capacity was one turbine a month. It has constantly increased in size and capacity and is now a modern, well-equipped plant with every means at its disposal to produce a superior product. Only 15 turbines were built in its first year, but now at the end of 16 years there are more than 7500 Terrys in operation.

Such growth means merit of product; merit due to correct engineering principles embodied in high grade design and manufactured with extreme care. Such growth means a turbine fulfilling the aim of the men behind it, and giving the fullest measure of service to the user. Such growth means a factory behind the product which can well afford to maintain repair parts for immediate shipment. Such growth means security, that in the years to come there will still be an organization backing the product of today.

The Terry Steam Turbine Co.
Terry Square, Hartford, Conn.

T 704

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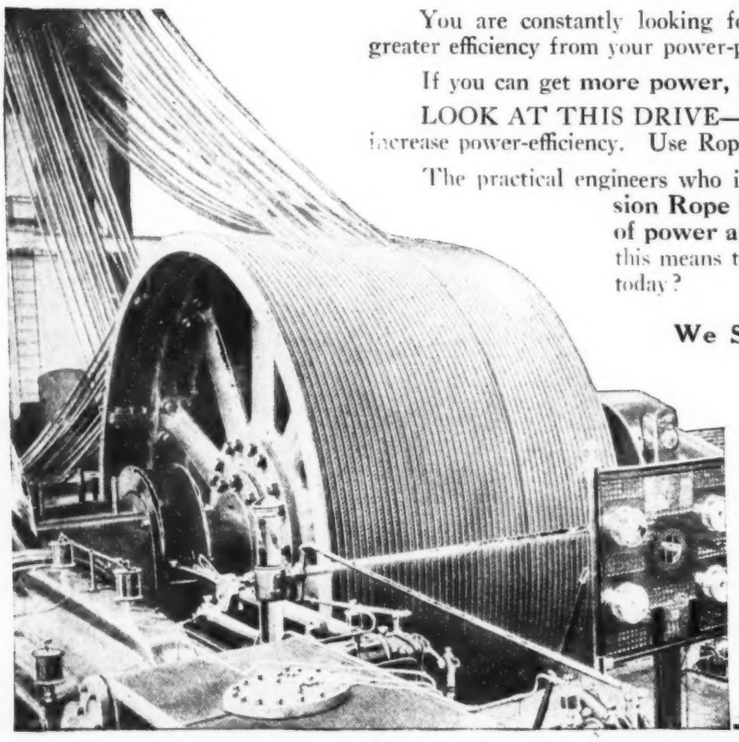

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Nogales, Ariz.

April 9th, 1920

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(Signed) H. W. Hamblin, Genl. Engr.

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